Salinas River State Beach
Dune Restoration and Management Plan

Central Coast Wetlands Group at Moss Landing Marine Labs
and Coastal Conservation and Research
in partnership with California Department of Parks and Recreation

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1. Existing Conditions and Background

Introduction

The following Restoration and Management Plan has been prepared by the Central Coast Wetlands Group (CCWG) and Coastal Conservation and Research (CCR) in partnership with the California Department of Parks and Recreation (DPR). This document will help guide the restoration and monitoring of sand dune habitat within Salinas River State Beach (SRSB) in Moss Landing, California. No development or construction of buildings is included in this plan, only the installation of fencing, walking paths and educational signage.

Site Description

The restoration site is located in North Monterey County, CA (Figure 1). The restoration site is located within SRSB, which comprises approximately 280 acres of beach and coastal dunes. Approximately 140 acres of SRSB is dune habitat. SRSB is bordered by the Pacific Ocean to the west and the old Salinas River channel and agricultural fields to the east. SRSB extends northward to Sandholdt Road in Moss Landing and southward to the Salinas River mouth, wrapping around the Monterey Dunes colony in the lower half of the state beach. The most prominent feature of the state beach is the extensive sand dune system, which extends inland in some places for over 1000 feet and is 50–60 feet above sea level at the highest point.

The SRSB was classified as a state beach by the California State Park and Recreation Commission in November 1962, to "protect and perpetuate the area's natural resource values and to provide beach-oriented recreation opportunities for the enlightenment, inspiration, and enjoyment of present and future generations (DPR 1987). The State Park and Recreation Commission resolution establishing the state beach specifically distinguishes the foredune and coastal scrub plant communities, the solitary sandy beach, the visual texture of the dunes and the expanse of Monterey Bay as the important elements. SRSB is also zoned as "scenic and natural resource recreation" in the North County Land Use Plan and "recreational" within the Monterey Bay National Marine Sanctuary.

The entirety of the SRSB lies within the California Coastal Zone, consequently potential human-caused alteration (e.g., development) or impacts to "environmentally sensitive habitats (ESHAs)" are subject to review under the California Coastal Act, Article 5, Section 30240(a). The provisions of the Coastal Act are administered locally by the California Coastal Commission in cooperation with Monterey County. Chapter 3 of the Coastal Element describes the specific development activities that are permitted within ESHAs, including coastal dunes and wetlands (CCC 1976).

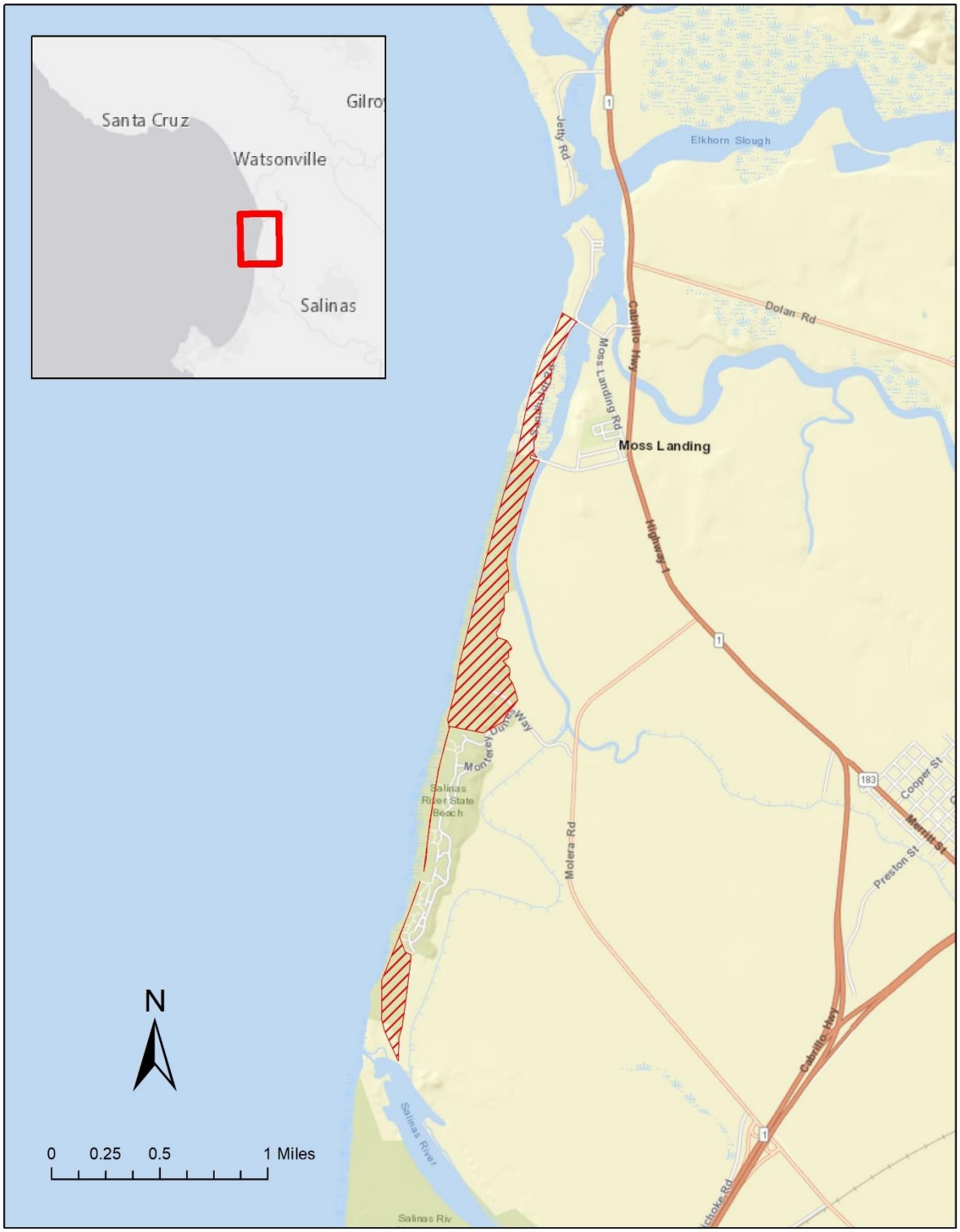

Figure 1. Site vicinity map.

Note: Monterey Dunes Colony is responsible for their own dune restoration program.

SRSB contains rare coastal dune and coastal marsh ecosystems which provide habitat for many species of wildlife and migratory birds, and which host numerous special status animal and plant communities. SRSB also contains two subunits classified as Natural Preserves: the Salinas River Dunes Natural Preserve and the Salinas River Mouth Natural Preserve. The qualities that make this area a haven for wildlife and a hotspot for rare plant communities also attract visitors who seek open space, solitude and a natural landscape relatively untouched by development. Beach combing, bird watching, photography, jogging, horseback riding and surfing are popular recreational uses of the state beach, but it is common for visitors to have the beach to themselves, especially in winter.

There are three public parking and access locations associated with the SRSB. One is located at the Sandholdt Road access at the north boundary of SRSB. It is paved and has space for approximately 40 vehicles. It provides pedestrian access only, and is also owned by DPR. The Potrero Road parking is unpaved, and has space for approximately 60 vehicles. It provides pedestrian and equestrian access to the beach. Similarly, the Molera Road parking lot is paved and has space for approximately 50 vehicles. It offers pedestrian and equestrian access to the beach and is owned by DPR. Portable toilets and trash cans are located in each public parking lot and are the only facilities associated with the state beach.

With only these three public entry points for this 3.6 mi (5.6 km) long area of the state beach, much of the use occurs near these locations. Between Sandholdt and Potrero Roads, visitors can follow a trail that runs behind the dunes along the Old Salinas River channel. South of Potrero Rd, the lateral dune/horse trail provides pedestrian and equestrian access along the dune between the Potrero Rd and Molera Rd access points. There are numerous trails between private homes within the Monterey Dunes Colony and the beach that are managed by the Dunes Colony. Many volunteer/unsanctioned trails run from the ridge trail through the dunes to the beach. Equestrians are directed to ride on the ridge trail or on the beach on the wet sand to protect sensitive plant and animal species. Due to the dynamic nature of the shore environment, conditions along the beach and dunes are constantly changing.

Just south of the Sandholdt Road access, is a privately owned 2-acre parcel sandwiched between SRSB owned land. This location has become an unsanctioned dune and beach access way as there is no fence keeping people from accessing the dunes from the back dune trail. This parcel, as of 2021, is currently in the process of being acquired by the Elkhorn Slough Foundation, and at that point would be transferred to DPR and covered within this Plan.

Figure 2. Privately owned parcel adjacent to SRSB for potential dune restoration

PLANTS AND ANIMALS AT THE DUNES

Plant and animal species that inhabit the dunes are specially adapted to the dynamic system of moving sand and wind. Plants that grow within the permeable, blowing substrate are either short-lived or persist through the development of deep, extensive root systems. Vegetation patterns within the dunes are strongly correlated with dune morphology (Pickart 1998). Seedling establishment is variable depending upon the species and micro-environments to which the seeds are carried. Animals that inhabit coastal dune habitats are subject to physical stresses that include sand movement, salt spray, temperature variability, wind, and disturbances such as storms. Their adaptations are mostly behavioral. Species such as western snowy plover shelter in depressions in the sand in the coastal strand where they also forage and breed. Invertebrate species such as globose dune beetle complete their entire life cycle in the dune habitat. SRSB supports populations of federally and state listed and special status animal species, plant species, and plant communities and several species endemic to California.

Plants

There are three plant communities at SRSB: foredune, coastal scrub, and palustrine wetland (a seasonal pond located with the dune system) (DPR 1987). The most common plant species within the foredune are sand verbena (*Abronia umbellata* and *A. latifolia*), beach bur (*Ambrosia chamissonis*), beach sagewort (*Artemisia pycnocephala*), beach saltbush (*Atriplex leucophylla*), and beach pea (*Lathyrus littoralis*), all native species, and sea rocket (*Cakile maritima*), sea and hottentot fig (*Carpobrotus chilensis* and *C. edulis*) and European dune grass (*Ammophila arenaria*), all non-native invasive species. The coastal scrub community occupies a narrow strip between the foredune and the old Salinas River channel (DPR 1987). The most common species within this mid-dune area are mock heather (*Ericameria ericoides*), coast buckwheat (*Eriogonum latifolium*), lizard tail (*Eriophyllum staechadifolium*), bluff lettuce (*Dudleya farinosa*), and hottentot fig (*Carpobrotus edulis*). The dune pond in the southern end of SRSB was created by the shifting mouth of the Salinas River. The pond is seasonal and is surrounded by a sparse cover of sedges, rushes and grasses (DPR 1987).

Several special status plants and plant communities occur within the SRSB dune system including Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and sand-loving wallflower (*Erysimum ammophilum*), as well as central dune scrub, central foredune, and northern coastal salt marsh communities (Table 1, Figure 3) (Holland 1986, CDFW 2019).

Table 1. Special status plant species and plant communities list

Common Name	Scientific Name	Source
Plant species		
Monterey gilia	*Gilia tenuiflora* ssp. *arenaria*	CDWF 2019, Watson et al. data 2019-2020
Monterey spineflower	*Chorizanthe pungens* var. *pungens*	CDFW 2019
Sand-loving wallflower	*Erysimum ammophilum*	CDFW 2019, Cal flora 2021
Plant Communities		
Central dune scrub	N/A	Holland 1986, CDFW 2019
Central foredunes	N/A	Holland 1986, CDFW 2010
Northern coastal salt marsh	N/A	CDFW 2019

Figure 3. Distribution of special status plant species within SRSB and adjacent dune areas (CDFW 2019).
Note: CDFW CNDDB map layers are clipped to the SRSB boundary. Central foredune not mapped within CNDDB.

Although there is a wide diversity of native species present in the SRSB, a 2015 analysis of aerial imagery revealed that ice plant cover of the vegetated foredune ranged from about 35 to 70 percent. Non-native invasive ice plant spreads through seed production and vegetative propagation, tolerates a range of soil moisture and nutrient conditions and can establish and grow in the presence of herbivores and competitors. These qualities enable ice plant to out-compete many native species and dominate resources, including space. In areas where ice plant has died and regrown, the build-up of organic matter can enable invasion by other non-native plants that would not ordinarily establish in the normally sandy soils.

Animals

There are many invertebrate and vertebrate species found at SRSB. The beach and littoral zone are used by resting, feeding and nesting gulls and shorebirds. Observations include Caspian and elegant terns (*Hydroprogne caspia*, *Thalasseus elegans*, and *T. maximus*, respectively), many species of shorebirds, gulls, and waterfowl, such as sanderlings (*Calidris alba*) and willets (*Tringa semipalmata*), Heermann's, California and Western gulls (*Larus heermanni*, *L. californicus*, and *L. occidentalis*, respectively), many of which may feed on small crustaceans, molluscs and worms in the sandy intertidal. Vegetation in the foredune and coastal dune scrub communities provide food, cover, and nesting sites for many species of insects, birds, amphibians, reptiles and mammals. Velvet ants, ground-nesting wasps and bees, scarab and dune beetles and many other insects live in the dunes. Harriers and songbirds may forage on the plants and animals found in the dune scrub plant community. Amphibians and reptiles include the Pacific tree frog (*Pseudacris regilla*), Coast garter snake (*Thamnophis elegans terrestris*), and the northern alligator lizard (*Elgaria coerulea*). Mammals such as coyotes (*Canis latrans*), raccoons (*Procyon lotor*), feral cats (*Felis catus*) and non-native red foxes (*Vulpes vulpes*) may hunt birds and smaller mammals in the dune habitat.

There are several special status animals that occur within or adjacent to SRSB including globose dune beetle *(Coelus globosus)*, California legless lizard *(Anniella pulchra)*, tidewater goby *(Eucyclogobius newberryi)*, western snowy plover *(Charadrius nivosus nivosus*), Salinas harvest mouse (*Reithrodontomys megalotis distichlis*), and short-eared owl (*Asio flammeus)* (Table 2, Figure 4, Figure 5) (CDFW 2019, UFWS 2011, Point Blue 2020). Avoidance measures to reduce disturbance to special status species found within or adjacent to restoration sites are found in Appendix A.

Table 2. Relevant special status animal species list with occurrence found within or adjacent to SRSB

Common Name	Scientific Name	Observed Occurrence Accuracy/Proximity & Source
Black legless lizard	*Anniella pulchra nigra*	Within SRSB boundary (CDFW 2019)
Globose dune beetle	*Coelus globosus*	Within SRSB boundary (CDFW 2019)
Salinas harvest mouse	*Reithrodontomys megalotis distichlis*	Within 1/5 mile (CDFW 2019)
Short-eared owl	*Asio flammeus*	Within 1 mile (CDFW 2019)
Tidewater goby	*Eucyclogobius newberryi*	In Salinas River estuary (CDFW 2019)
Western snowy plover	*Charadrius nivosus*	Within SRSB boundary (CDFW 2019, UFWS 2011, Point Blue 2020)

Figure 4. Distribution of special status mammal and bird species within SRSB and adjacent dune areas (CDFW 2019, USFWS 2011). *Note: CDFW CNDDB map layers are clipped to the SRSB boundary.*

Figure 5. Distribution of special status reptile, fish and insect species within SRSB (CDFW 2019).

Note: CDFW CNDDB map layers are clipped to the SRSB boundary.

Dunes and Ice plant

The five kilometer sand dune complex spanning the central Monterey Bay from the Moss Landing harbor mouth southward to the Salinas River Mouth is part of an ancient dune system that formed and stabilized during the Wisconsin glaciation (Dorrell-Canepa 2005). Dunes within the central Monterey Bay accrete sand through a complex interaction of littoral transport south from the Santa Cruz littoral cell to the mouth of the Monterey Bay Submarine Canyon at Moss Landing and local deposition of fresh sands from the Salinas River immediately south of the canyon. Strong seasonal winds and changing wave patterns drive beach sands inland forming an extensive dune complex.

Historically, the Salinas River flowed west towards the coast, then meandered north behind the coastal dunes complex. The river bisected the dunes at numerous locations between its current location and a location north of Elkhorn Slough. Periodically the Salinas met with the mouth of the Pajaro River. Between 1854 and 1910 the mouth was located north of the current Moss Landing Harbor mouth in what is now Bennett Slough (Figure 6). In 1910 the Salinas River mouth was manually opened at its current location directly west of the point where the river previously transitioned north behind the dunes. In 1946 the Moss Landing Harbor Mouth was constructed, permanently bisecting the Salinas dunes complex.

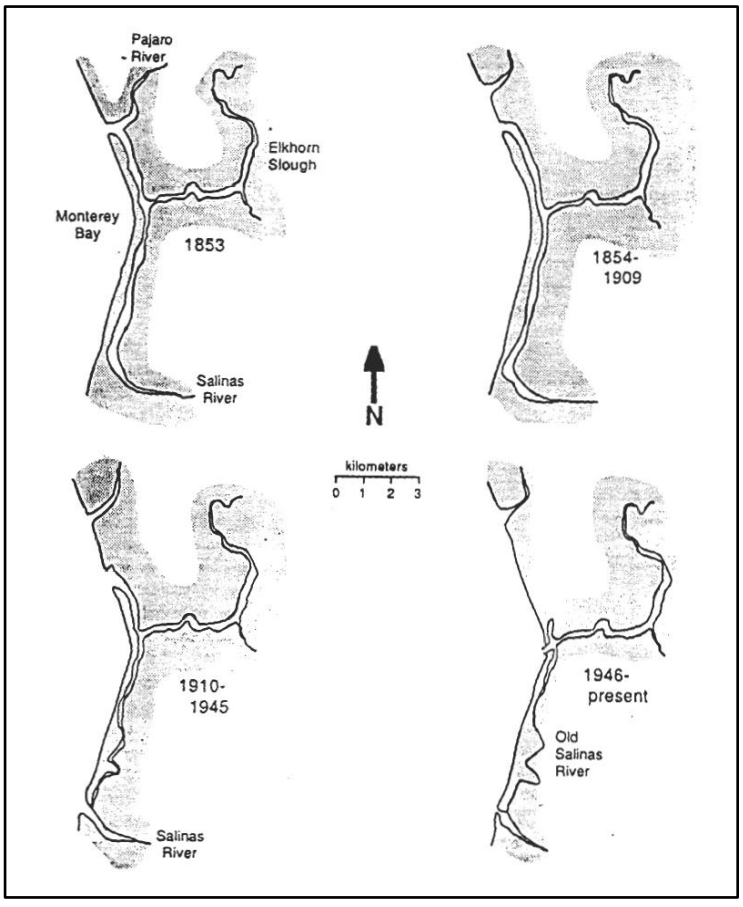

Figure 6. Historical flows of the Salinas River

Invasive Ice plant Impacts on Central Coast Dunes

As development pressure expanded in the early 20th century, within and adjacent to the central Monterey dune system, there was a perceived need to stabilize the dunes and limit natural dune migration and sand movement. Initially, ice plant was populated along the coastal railroad corridor and later the species was actively planted by the military and state agencies (Cal Trans) to stabilize dune systems and protect adjacent properties from drifting sand (Au 2000).

The California Invasive Plant Council (Cal-IPC) classifies the impact of ice plant (*Carpobrotus edulis*) on native ecosystems as *high*. Species with a *high* rating have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure and their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment (Cal-IPC 2006). *C. edulis* effectively eliminates other species within areas it colonizes through several competitive advantages, leading to monotypic stands of this single species. *C. edulis* can reproduce through seeds dispersed by animals and through fragmentation and regrowth. Ice plant establishes a dense cover of plant material that eliminates open dune space and impedes recruitment of native species, especially species that require periodic disturbance for recruitment (D'Antonio and Mahall 1991).

Loss of Native Species Diversity

The central Monterey Bay dunes system once reported supporting more than 70 species of native plants (DPR 1985). Today, at least 50 species of native plants can still be found within the SRSB dune system (A. Palkovic, personal communication, June 2020) but the abundance of many of these species has been reduced significantly. Species of particular interest to be included in restoration efforts at SRSB include the Monterey spineflower (*Chorizanthe pungens*) and Sand gilia (*Gilia tenuiflora*). Both species benefit from natural dune systems devoid of ice plant that exhibit periodic disturbance and open sand areas. The removal of dense ice plant will allow for greater open area for the recruitment of native species including spineflower and gilia.

Ice plant Cover and Distribution

Ice plant has recruited and now dominates much of the SRSB dune complex. Initial (2015) aerial estimates of ice plant percent cover within the foredune of SRSB are shown in Table 3. The remainder of the dune plant community is comprised of a mix of mostly native species.

Table 3. Ice plant cover estimates (2015) within foredune areas at SRSB.

Dune Restoration Section	% Ice plant of Total Veg Cover
Sandholdt Rd access to Potrero Rd access	50-70%
Potrero Rd access to Molera Rd access	35-65%
Molera Rd access to Monterey Dunes Colony	50-60%
Salinas River Mouth	35-60%

Previous Dune Restoration Efforts in Moss Landing

Continued restoration of dune habitat at SRSB creates a necessary connection between previous efforts at SRSB as well as adjacent restoration projects, including the Moss Landing State Beach Coastal Dune Revegetation Project to the north and the Monterey Dunes Colony restoration site closer to the southern boundary of SRSB, and a historical project, the restoration of sand dunes at Moss Landing Marine Laboratories (Figure 7).

Figure 7. Locations of previous restoration areas within and adjacent to SRSB

Phase 1 Salinas River State Beach Dune Restoration and Resiliency Effort

Central Coast Wetlands Group at Moss Landing Marine Labs and Coastal Conservation and Research have worked since 2016 in partnership with State Parks to restore sensitive dune habitat at SRSB between the Moss Landing Harbor and Salinas River mouth. Restoration activities were guided by the 2016 version of this restoration plan and funded by the California State Coastal Conservancy. Ice plant was eradicated from 20 acres of priority dune habitat within SRSB, through spraying of herbicides and hand pulling. Sprayed ice plant was left in place to act as mulch for native plants. Seeds from native plants collected from the SRSB dunes complex were propagated and planted during the rainy season. Efforts to increase the structural integrity of the dunes included strategic use of drift wood and hay bales to help accrete sand to build dunes. Trail and access point upgrades included installation of fencing along the western edge of the Sandholdt Road parking lot/entrance (530 feet) to better delineate access ways and reduce wayward foot traffic through sensitive dune habitat. Interpretive signs were also installed at the Molera access parking lots (one 3 paneled-kiosk with sign panels), the Potrero Road access parking lots (2 wayside signs), and along main dune trails (10 "kindly keep off the dunes" signs) to provide education about sea level rise, dune erosion, habitat restoration, and endangered species. Key findings from Phase 1 were used to help inform restoration methods discussed within this plan.

KEY FINDINGS OF PHASE I RESTORATION ACTIVITIES INCLUDE:

1. **Herbicide Application**: precision spraying by professional herbicide application teams leads to limited die off of interspersed native vegetation hand pulling of ice plant is more destructive to adjacent native plants in many cases than precision spraying of ice plant.

2. **Native Plant Response - Percent Cover**: native seed bank is often sufficient to support native plant recolonization of areas with dead ice plant, and **Plant Richness**: native planting palette should focus on increasing native plant diversity.

3. **Dead Ice plant as Mulch**: sprayed ice plant that is left in place provides a protective layer (mulch) that helps native plants establish. The dead ice plant is not a barrier to native seed bank germination, and dead ice plant provides stability and limits dune erosion and invasion of invasive species.

4. **Value of Local Restored Areas as Reference Sites:** Expected native plant cover and diversity are unknown since this entire dune system has been colonized with ice plant for many decades and local plant data are not representative of expected natural cover of species due to this non-native species dominance and thus, we have found that areas that were restored early and have been a focus of long term maintenance such as annual spot spraying or hand pulling of iceplant recruits, provide good reference conditions to determine cover and diversity expectations for future phases of the restoration effort.

These findings are discussed in more detail in Chapter 2 (An Adaptive Management Approach).

Monterey Dunes Colony Restoration Activity

Monterey Dunes Colony is a 120 vacation home community on 125 acres of sand dunes that is bordered on the north, south, and west by the SRSB. The Monterey Dunes Colony recently initiated a small demonstration project in which they brought in sand and recontoured foredunes to 3–4 ft. above grade and then planted the new dunes with local native seeds and seedlings. The total project area was approximately 1000 square feet. The project was conducted to demonstrate to DPR and the California Coastal Commission that importing sand could be done without negatively impacting DPR land or western snowy plovers. This work began in January 2015.

Moss Landing State Beach Restoration Activity

Moss Landing State Beach (MLSB) consists of 66 acres of coastal sand dune, beach and salt marsh habitat and is located immediately north of the Moss Landing harbor inlet. Haphazard beach access has caused a loss of dune vegetation, resulting in blowout areas and sand moving into the Jetty Road. DPR and the Elkhorn Slough Foundation partnered to conduct dune restoration at MLSB, including eradication of non-native species, replanting of native dune plants, and maintaining beach access points to clearly delineate walking paths and prevent trampling of sensitive dune habitat. This work began in late 2013.

Moss Landing Marine Laboratories Restoration Activities

The beachside Moss Landing Marine Laboratories (MLML) campus was destroyed in the 1989 Loma Prieta earthquake. Part of the rebuilding effort of MLML included sand dune reconstruction and restoration on a 2-acre parcel where most of the buildings and structures of the labs had been prior to their destruction. The site was heavily disturbed due to trampling from people crossing the dunes to get to the beach from the parking lot. Reconstruction and restoration included recontouring the sand dunes, removal of ice plant, propagation and planting of native dune plants, and placement of signage and fencing to protect the vulnerable site. Work began in 1992 and was largely finished by 1999.

Dunes as Coastal Protection from Storms

Threats to Salinas Valley from Sea Level Rise

Several recent studies regarding coastal vulnerabilities to Sea Level Rise (SLR) have documented the adaptive capacity natural ecosystems can provide to protect coastal areas from those vulnerabilities. Langridge et al. 2013 documents the future vulnerability of the Salinas Valley to rising seas and models the protective capacity that natural sand dunes can play to protect the valley from storm induced flooding. This project will document the importance dune restoration can have to improve the resiliency of dunes to storm damage.

Specifically, native dune plants develop deep root systems that provide erosive resilience and support natural sand migration and accumulation patterns that are expected to dissipate wave energy without leading to significant dune face failure. The foredune plants form low sloping dune faces that encourage wave run-up energy to dissipate rather than undercut foredunes dominated by ice plant. Studies suggest that

the removal of ice plant and reestablishment of native species will enable dune complexes to better respond to wave impacts, which will enable them to be more resilient to more frequent and more damaging storms (De Lillis et al. 2004).

Dune Protection

The sand dune complex that parallels the central Monterey Bay between the current location of the Salinas River mouth and Moss Landing Harbor has been in place since the opening of the Harbor and the breaching of the Salinas River at its current location. The dunes provide a natural buffer from ocean derived processes (waves, sand deposition, salt spray) for the productive agriculture fields of the Salinas Valley. The historical Salinas River (now Old Salinas River channel) flows behind the dunes between the river and Moss Landing Harbor. Water elevation within the channel is regulated by the Old Salinas River slide gates at the river lagoon and the Potrero tide gates which limits tidal exchange with the harbor.

The Salinas Valley is most vulnerable to coastal flooding from storm induced wave run-up and dune overtopping at three locations between the Salinas River (with its levee protections) and the Potrero tide gates to the north. These locations all are dominated by invasive ice plant and are the narrowest sections of the dune system. These dunes are backed by agriculture fields, which limits future dune migration. Sand supply along this portion of the coast, adjacent to the Salinas River mouth is assumed plentiful and can support dune building processes.

Recent SLR hazard maps, created by the State Coastal Conservancy and ESA PWA (2014) for the Monterey Bay Coast, identify two sections of the SRSB as being highly vulnerable to storm induced dune and beach erosion and flooding, which will be exacerbated by SLR. A study conducted by the Center for Ocean Solutions in 2012 shows this area to be at the greatest risk of future dune erosion due to SLR. SRSB provides a natural ocean barrier to thousands of acres of low lying agricultural and wetlands resources that are protected from winter storms by these dunes (Langridge 2014). Sand dunes, in their natural state, dissipate wave run-up erosive energy and minimize ocean induced dune undercutting and inland flooding, while providing critical habitat to many special status species.

The natural dune vegetation at SRSB, however, has been disrupted by the introduction of ice plant (*Carpobrotus edulis and Carpobrotus chilensis*) and other invasive plants. Ice plant is an invasive species that has choked local dune systems and impacted important physical and ecological dune functions. The documented degradation of foredune habitat by invasive species undermines the dune's capacity to act as a protective barrier to SLR. Restoring impacted dune areas identified as being most vulnerable to SLR restore a unique and sensitive habitat of the Salinas River Dunes Natural Preserve and Salinas River Mouth Natural Preserve, but will also enhance the resiliency of the dune system from the multiple impacts of SLR.

2. An Adaptive Management Approach

Background on Development of Methods and Goals

Initial restoration efforts that took place at SRSB during Phase 1 (2016-2019) allowed the project team to investigate native and non-native plant species response to different restoration methods and take an adaptive management approach to better ensure Phase 1's broad set of restoration goals (eradication of ice plant, increase in native cover, and increase in foredune resiliency) were being met. Additionally, results from Phase 1 were used to refine goals and objectives for future restoration efforts. Adaptive management is an iterative process that incorporates new scientific and programmatic information into the implementation of a project or plan to ensure that the goals are being reached efficiently.

During Phase 1 (2016 – 2019) the team collected data on native plant cover, ice plant cover, and other non-native cover for the average (mean) of the perpendicular (west-east) vegetation point-intercept transects. Percent cover includes open sand areas of the dune system, not only the vegetation. Results from the surveys show that between 2016 and 2019 ice plant was reduced from 23% to 3% total cover, native cover increased from 27% to 36% total cover, and other non-native species cover increased from 1.8% cover to 2.4% total cover. Figure 8 shows changes in percent cover during this active restoration period, and should be understood as a summary of vegetation transect survey data collected during Phase 1.

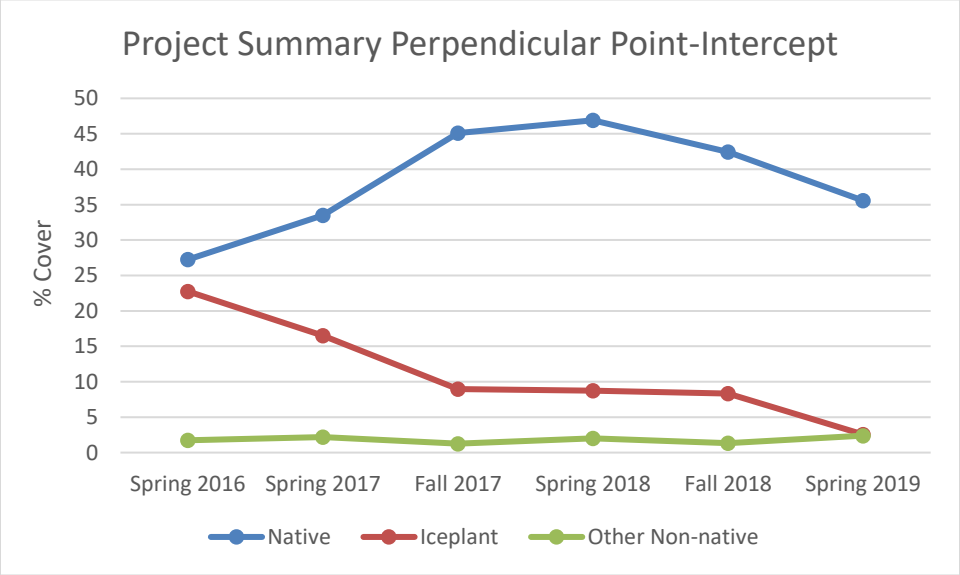

Figure 8. Average (mean) cover of vegetation transects for entire project area during project period (2016-2019)

The project team reviewed plant species response to methods such as precision application of herbicide to ice plant around natives, benefits of leaving ice plant in place as mulch, and native response with and without planting. Further investigations, observations and approaches discussed below helped inform restoration methodologies and refine the goals and objectives for ongoing restoration efforts as discussed within Chapter 3 of this Plan.

Herbicide Application

Due to concern for adjacent waterway contamination and adverse impact on amphibians, pollinators, and other species, local and state agencies usually restrict the use of herbicides. During Phase 1 eradication efforts, the restoration team limited the use of herbicide to large mats of ice plant, defined as greater than one meter in diameter with interspersed native cover of less than 40%. Part of this approach, which was intended to limit overuse and overspray of herbicide, meant hand-pulling any ice plant that was within ½ meter of native plants.

However, the restoration team found two unanticipated results during Phase 1. First, during this initial phase the team discovered that with careful application (precision spraying), overspray could be managed to within a few centimeters of native plants with no signs of native plant dieback or other adverse effects. Second, the team discovered that hand-pulling larger patches of ice plant near native plants led to root and foliage damage to the native plants, and to disturbance to dune structure that caused localized erosion (CCR restoration crew per com.).

Native planting and ice plant management in Phase 1 areas are being continued as part of Phase 2, but the findings outlined above have led to changes in the herbicide application approach for Phase 2. Rather than leave a larger buffer around native species, the team has been able to apply herbicide to smaller patches of ice plant (over ~1/2 meter diameter), and closer to native species, with the exact buffer dependent on the density of natives within the ice plant patch. As a corollary, the team has been able to limit hand-pulling to those areas around special status species, in areas where new ice plant recruits have sprouted, or where multiple seasons of herbicide application have been unsuccessful in eradicating all the ice plant and some small patches remain. Separate conditions are in place for herbicide application in areas that may have special status plant species. See Chapter 3.

Native Planting and Natural Seed Bank

As a starting point, in 2015 during the start of Phase 1, DPR staff provided a list of native plant species along with recommendations for relative plant cover of foredune and mid dune species (Table 4) (A. Palkovic, personal communication, Sept 3 2015). It should be noted that the relative cover percentages in the plant list were estimated by DPR staff based on local knowledge and not based on data collected in the field. This list was provided to be used as general guidance for the entire dune complex and not prescriptive

to specific sections of the dunes. This list was used to develop an initial plant palette for the restoration project during Phase 1.

Table 4. Native dune plants found at SRSB with guidance on relative cover for reestablishment of natives .

Species	Common name	Foredune Relative Cover	Mid-dune Relative Cover
Abronia latifolia	yellow sand verbena	15%	0
Abronia umbellata	pink sand verbena	0	3%
Achillea millefolium	yarrow	0	5%
Acmispon glaber	deer weed	0	5%
Ambrosia chamissonis	beach bur	15%	3%
Armeria maritima	sea thrift	2%	4%
Artemisia pycnocephala	beach sagewort	5%	5%
Astragalus nuttallii	Nuttall's milkvetch	0	5%
Atriplex leucophylla	beach saltbush	15%	0
Calystegia solanella	beach morning glory	10%	5%
Camissonia cheiranthifolia	beach primrose	15%	5%
Cardionema ramosissimum	sand mat	0	5%
Castilleja latifolia	seaside painted cup	0	5%
Chorizanthe pungens ssp. pungens	Monterey spineflower	0	2%
Corethrogyne filaginifolia	California aster	0	5%
Dudleya caespitosa	coast dudleya	0	5%
Ericameria ericoides	mock heather	0	5%
Eriogonum latifolium	coast buckwheat	0	10%
Eriophyllum staechadifolium	lizard tail	0	5%
Eschscholzia californica maritima	beach poppy	0	2%
Extriplex californica	California salt bush	5%	0
Gilia tenuiflora ssp. arenaria	sand gilia	0	1%
Lathyrus littoralis	Beach pea	3%	0
Leymus mollis	American dune grass	15%	0
Lupinus chamissonis	silver dune lupine	0	5%
Lupinus arboreus	yellow bush lupine	0	5%
Phacelia ramosissima	branching phacelia	0	5%
		100%	100%

During Phase 1 restoration efforts, the restoration team found that, after ice plant eradication, a well-established native seed bank provided successful native recruitment (CCWG 2019). This was evident by native plant cover increasing in areas where no planting had occurred (CCR restoration crew personal communication, CCWG 2019). This led to a change in the native planting and seeding approach for future restoration efforts, including putting less effort into plant propagation and out-planting and more effort into

ice plant eradication, and focusing native planting and seeding on increasing plant diversity where needed and planting native dune grass (*Leymus mollis*) along the foredune to increase foredune resilience.

Although Phase 1 did not set specific species richness objectives, Phase 1 studies did find that species richness was site dependent and not necessarily driven by management actions (CCWG 2019). Figure 9 shows species richness for each of the three restoration areas. It should be noted that this graph only reflects numbers of species encountered along established vegetation transects used for monitoring native and non-native cover, which did not include an exhaustive inventory of all species present within the restoration areas. There was no significant change in species richness between the beginning and the end of the project. The Potrero area had the greatest species richness, followed by the Salinas River mouth area, and then the Molera area. Changes in species richness do not appear to change as a result of ice plant removal but rather are found to differ among study site locations and with changes in season (most likely due to expression of annual species in different seasons). For restoration efforts moving forward, the restoration plan will focus on propagation of less common species that do not naturally recolonize after ice plant eradication.

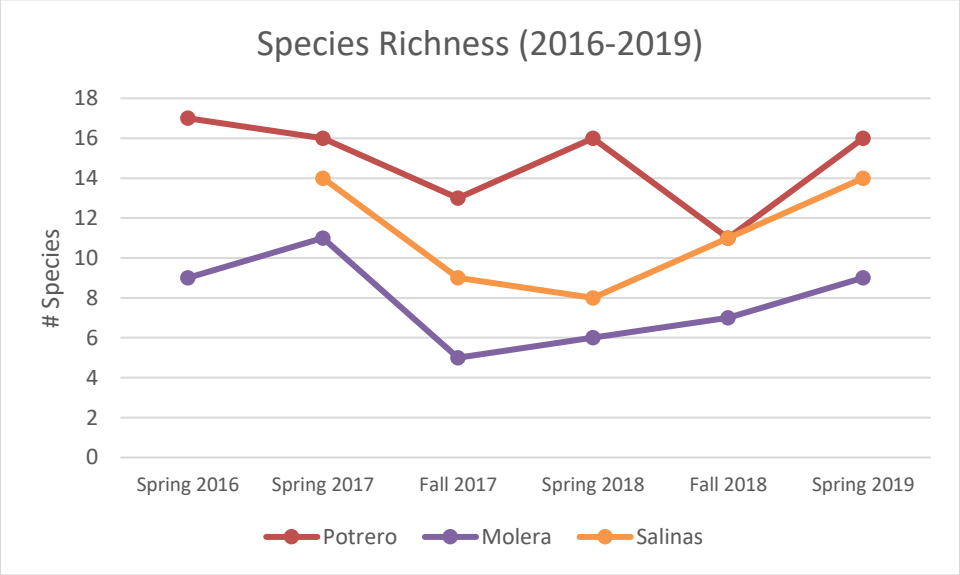

Figure 9. Species Richness within each Restoration Area (Potrero, Molera, Salinas River) over time.

Benefits of Leaving Dead Ice plant in Place as Mulch

Experimental study plots studied in Phase 1 (2017-2019) compared treatments that removed ice plant to treatments that left dead ice plant in place as mulch after the first year of herbicide application (CCWG 2019). Treatments with the dead ice plant mulch showed a significant reduction in invasive species recruitment, whereas removal of the ice plant led to opening of bare sand that presented opportunities for invasive plant recruitment (Figure 10). Treatments that left dead ice plant in place as a mulch layer showed no significant negative impact on plant survivorship or native recruitment from seed (Figure 11). In fact,

results showed that dead ice plant left in place as mulch allowed for a slightly greater increase in native cover than their treatment counter parts in which the dead ice plant was removed.

The dead ice plant was found to act as a successful mulch that helped keep sands moist for newly planted native species and did not significantly hinder recruitment of native plants from available seed bank and seed dispersal efforts. Furthermore, dead ice plant left in place showed to have less recruitment of new ice plant. These results provide the basis to continue leaving dead ice plant in place as mulch after herbicide application.

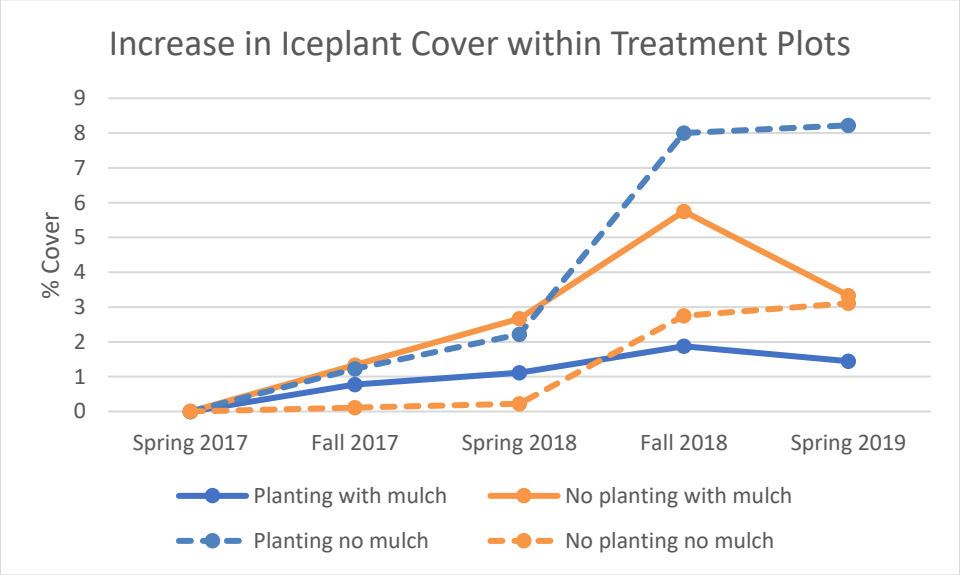

Figure 10. Average (mean) percent total cover of ice plant for treatments (planting vs no planting and with mulch vs. without mulch) throughout study period (2017-2019. Same colored lines are the same planting treatment. Solid vs dashed lines show whether ice plant was left in place to act as mulch (solid) or removed completely from the plot (dashed).

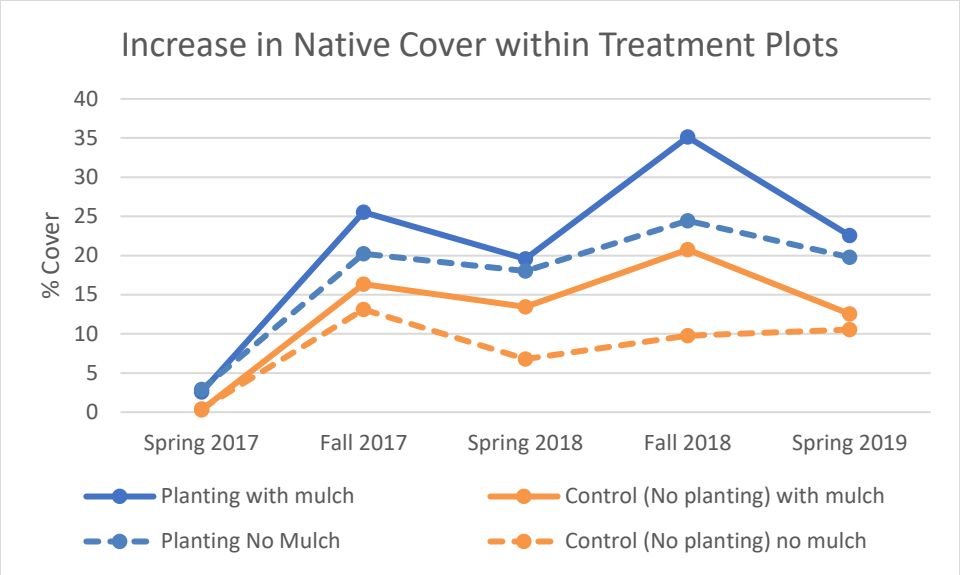

Figure 11. Average (mean) percent total cover of natives for treatments (planting vs. no planting and with mulch vs without mulch) throughout study period (2017-2019). Same colored lines are the same planting treatment. Solid vs dashed lines show whether ice plant was left in place to act as mulch (solid) or removed completely from the plot (dashed).

Use of Phase I Areas as Reference Sites

Ice plant has dominated the SRSB dune complex for decades and historical plant cover data are not available. During Phase 1, expected results of ice plant eradication and native planting efforts were unknown for these local dunes since restoration in this area was limited to a small 20 year old project (the Moss Landing Marine Labs Shore Lab restoration project) on one area of dune where ice plant had since recolonized. Therefore, updated restoration objectives are informed by documented success in previously restored portions of the dunes during Phase 1 (Figure 12) after five years of restoration. Figure 13 summarizes percent cover of native, non-native, and abiotic features, within reference areas as of 2020, for the three Phase 1 restoration areas (Potrero, Molera, and Salinas River Mouth). Reference data were collected in October of 2020 along 50 meter transects, that were established in 2016 as long-term monitoring transects, using the point intercept method. Please see above sections for more details on change in plant composition within the Phase 1 area over the restoration period (2016-2019).

Surveys of Phase 1 areas documents site specific variability in cover and diversity (CCWG 2019), likely the result of micro-climate and topographic differences (e.g. dune width, height, wind exposure) between the areas. For instance, due to low dune height and proximity of the dunes to the Salinas River in the Salinas River mouth section, bare sand cover in this area is naturally higher than the dunes farther north by the Sandholdt Road and Potrero Road access trails. Furthermore, restoration efforts and success may vary by section depending on ease of access for treating ice plant, ease of access for delivering plants to the site, and amount of unsanctioned foot traffic through the dunes.

Figure 12. Restoration Areas during Phase 1 (2016-2019)

Phase 1 results found that once ice plant is eradicated through spraying and hand pulling methods, cover of native plants are expected to increase over pre-restoration measurements (CCWG 2019). Restoration objectives for new restoration areas seek to reach a similar percent cover to Phase 1 areas that are in close proximity and share similar dune characteristics (e.g., dune width, height, bare ground cover), with a minimum of 50% absolute cover. Table 5 outlines what can be expected (based on results from Phase 1) for native and non-native plant cover, by section for new restoration areas five years post restoration initiation. These findings suggest that overall in active restoration areas ice plant cover can be reduced to below 5% absolute cover after 2-3 applications of herbicide and hand pulling, and native plant cover can be increased to greater than 50% absolute cover through natural recruitment and strategic planning of natives.

As part of the next phases of work, we will continue to investigate the time and steps needed to keep dunes "free" of ice plant.

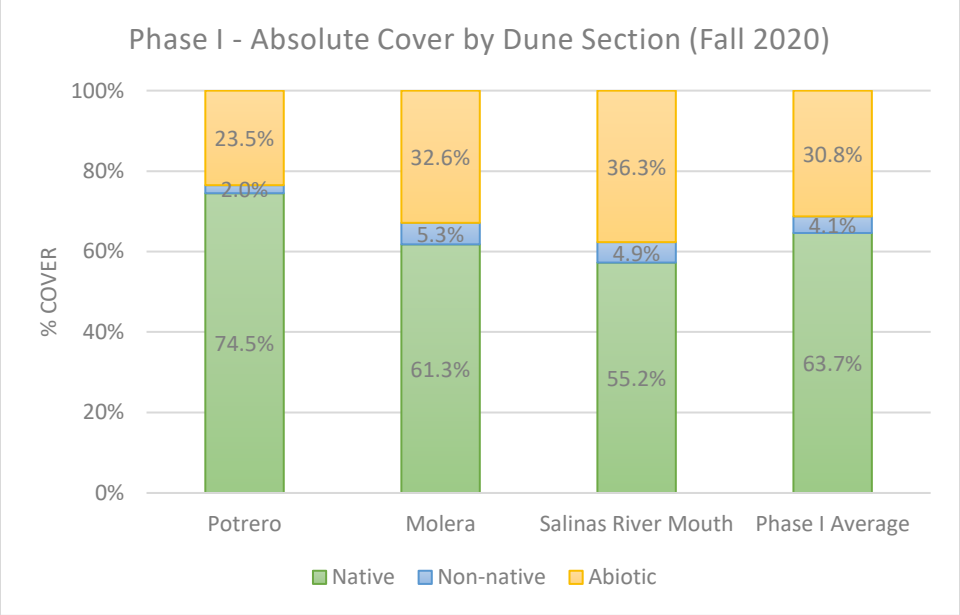

Figure 13. Percent cover within Phase 1 restoration areas. Data collected in Fall of 2020.

Table 5. Expectations for absolute cover of native and non-native plants for different sections of the SRSB dunes at 5 years post restoration initiation.

Dune Section	% Native Cover	% Non-native Cover
Sandholdt Rd access to Potrero Rd access	> 70%	< 5%
Potrero Rd access to Molera Rd access	> 65%	< 5%
Molera Rd access to Monterey Dunes Colony	> 60%	< 5%
Monterey Dunes Colony to Salinas River Mouth	> 50%	< 5%
Overall Objective for % Cover	**> 50%**	**< 5%**

3. Restoration Plan: Goals & Actions

Summary

CCWG and CCR will work in partnership with DPR to restore sensitive dune habitat at SRSB (Figure 14). This restoration plan will guide ongoing efforts to eliminate ice plant and other invasive plants from the dune system, increase native plant cover and diversity, increase foredune resiliency to wave impacts, and support overall DPR management of the dunes. The following four comprehensive Goals are discussed in more detail throughout this chapter:

- Goal 1: Control invasive vegetation at the SRSB dune system.
- Goal 2: Increase native plant cover and establish a diverse native plant species composition in SRSB restored dunes
- Goal 3: Enhance storm resilience of the SRSB dune system.
- Goal 4: Support DPR in efforts to enhance long-term management (maintain safe access ways and minimize recolonization of ice plant) of SRSB.

We anticipate ongoing partnerships with state agencies, local NGOs, and land owners to implement this plan through a number of incremental restoration activities, the first of which is the completed Phase 1 restoration effort conducted from 2016 to 2019.

Ice plant will be controlled primarily through the use of hand spraying herbicide (typically using a 2% dilution of glyphosate). Sprayed ice plant will be left in place to act as mulch for native plants. Ice plant will be left to decompose for approximately 4–9 months before native plants are planted within it. Hand pulling of ice plant will be used directly around native plants where live ice plant remains after herbicide application, in areas where special status plant species are present, and to remove new sprouts. If the native pant community does not respond as expected to removal of iceplant, then additional measures will be taken to increase native cover and diversity such as seeding and planting. Seeds from native plants for propagation and hand broadcasting will be collected from the SRSB dunes complex to ensure local genetic diversity is supported. Native plants will be propagated and planted during the rainy season. If needed, seeds will be hand broadcast and lightly raked into dune areas with bare sand. Native and non-native plant cover objectives for new restoration areas were informed by Phase 1 results and seek to reach less than 5% ice plant cover and greater than 50% native cover.

Efforts to increase the storm resilience of the dunes will include strategic planting placement and the use of drift wood, hay bales, or jute fencing to increase the structural integrity of the dunes. Trail upgrades will be made that include updating or replacing fencing to help better delineate access ways and reduce wayward foot traffic through sensitive dune habitat. Interpretive signs may be installed at three main access locations and along main dune trails to provide education about sea level rise, dune erosion, habitat restoration, and endangered species. Additional efforts will support DPR in long-term management of the dunes.

Figure 14. Restoration areas targeted for invasive species control and reestablishment of native dune vegetation. Trail and access locations are potential areas for fencing and signage.

GOAL 1. CONTROL INVASIVE VEGETATION WITHIN SRSB DUNE SYSTEM

Objectives

- **OBJECTIVE 1.1**: Within 5 years of initial treatment for a given restoration areas, absolute cover of ice plant will be reduced to less than 5% and maintained thereafter.
    - Success Criteria 1.1.1 Absolute cover of ice plant is less than 5% throughout the restoration area(s)
- **OBJECTIVE 1.2:** Within 5 years of initial treatment for a given restoration areas, absolute cover of *Ammophila arenaria* will be reduced to less than 0.5% and maintained thereafter.
    - Success Criteria 1.2.1 Absolute cover of *Ammophila arenaria* is less than 0.5% throughout the restoration area(s)
- **OBJECTIVE 1.3**: Within 5 years of initial treatment for a given restoration areas, absolute cover of *Arundo donax* will be reduced to less than 0.5% and maintained thereafter.
    - Success Criteria 1.3.1 Absolute cover *Arundo donax* is less than 0.5% throughout the restoration area(s)

Restoration Actions

CONTROL OF ICE PLANT THROUGH HERBICIDE APPLICATION AND HAND-PULLING (ACTION TO MEET OBJECTIVE 1.1)

Efforts to control ice plant at the SRSB dunes complex will include herbicide application and hand pulling methods as discussed below.

1. **Herbicide Spray Application**

   A field crew of 2–4 members will be responsible for spraying ice plant within the restoration area (Figure 14). Herbicides will only be applied using targeted methods (i.e., backpack sprayers or a spray rig with a hand held wand method); no broadcast (aerial) treatment methods will be employed. This targeted application reduces potential impacts associated with application of herbicides to nontarget vegetation. Spraying will occur approximately 4–9 months (depending on rate of iceplant die-off) prior to revegetation efforts to allow enough time for the ice plant to decompose and allow for easier planting. Areas with thick mats of ice plant may need to wait until after a second year of spraying before planting. In areas with native species are intermixed, ice plant will be sprayed in late fall when the natives are essentially dormant and germinating native seedlings are limited. In weedy, disturbed areas, ice plant can be sprayed in early to late spring so that the annual weeds are also eliminated before their seed is dispersed.

   Crew members will be trained to properly identify ice plant and native dune species (including *Dudleya*) and will have state certifications to use the spray application equipment. A 2% dilution of glyphosate (+ surfactant solution) with added tracer die will be used. Ice plant will be spot sprayed

in linear swaths parallel to the shore by the field crew in a manner that limits dune trampling. Spraying will be limited to when winds are no more than 10 mph with extra caution taken when at 5-10 mph, and not within 24hr of predicted or observed rainfall, to prevent chemical drift from wind and rain. A second application will be completed approximately 3–12 months after the initial application to address areas where ice plant remains robust. Treatment areas with an insufficient rate of kill will be re-treated up to three times in a five year period to ensure the target species has either been eradicated or reduced to a maintenance level. Sprayed ice plant will be left in place to act as mulch for new native plants.

In many places, native species are intermixed with the ice plant and therefore care will be taken to minimize drift or overspray of herbicides on native plants. Precise spraying (i.e. using a targeted spraying method and minimizing overspray to within 5-10cm of ice plant) will occur around native plants so as to avoid adverse impacts on native plants, while maximizing ice plant treatment effectiveness. Precise herbicide application has been found to be an effective technique and does not cause a reduction in native plant cover as documented in Phase 1 vegetation surveys and on the ground observations. In areas where native planting or seeding occur, herbicide spraying will be limited to areas where overspray will not jeopardize native plants. The conditions for herbicide spraying that targets ice plant is as follows:

1. Initial herbicide application of patches of more than 1/2 meter diameter, and with less than 40% natives intermixed.
2. Second application within a year (3-12 months after first application), if initial spraying does not result in significant die-off.
3. Third spraying the following year, if cover of ice plant remains above 25% over a 2x2 meter plot area.
4. If hand removal is determined to have caused impacts to native plants or has destabilized dune integrity in non-herbicide treated areas, herbicide may be considered if determined to be the environmentally least damaging alternative.

Once ice plant cover has been reduced to less than 10% (measured in 2x2 meter plots), the remaining ice plant will be removed by careful hand pulling.

2. Hand-pulling

Hand pulling of ice plant will be employed to remove small patches of ice plant (less than ½ meter square), remove larger patches where herbicide has been unsuccessful after two to three applications, or where ice plant has resprouted and it is easy to remove by hand. Small patches of ice plant may be hand pulled whenever staff familiar with the eradication procedures is on site. Pulled ice plant will be piled and left with roots facing upward to be sundried to prevent recolonization. This method is preferable because hauling ice plant offsite for disposal is labor intensive, cost prohibitive, and leads to greater trampling of the dunes. While a portion of this pulled material may become reoriented and recolonize, piling pulled ice plant with roots facing

upwards minimizes regrowth and allows for targeted removal of recruits through hand pulling or spraying.

Control of European beach grass (Action to meet Objective 1.2)

Ammophila arenaria is present in a few locations at SRSB including near the Salinas River mouth as well as near the Sandholdt Road beach access trail on the northern side of SRSB. Herbicide application staff will treat the area with 2% glyphosate/1.5% imazapyr mix + surfactant solution during at least two application periods. Additional spot checks will determine the effectiveness and additional treatment requirements. Native dune grasses will be planted in place of the European populations after spraying ends.

Control of Arundo (Action to meet Objective 1.3)

Arundo donax is present near the southern end of the restoration area near the Salinas River mouth. Efforts will be made to eradicate the species from this area. The *Arundo* will be treated either through a foliar application or cut by mechanical means and the cut stump will be treated with a 50–100% solution of glyphosate. Additional spot check applications will be made to ensure treatment is effective.

Long-term Weed Eradication and Control (Action o Meet Objectives 1.1, 1.2, 1.3)

Spot check surveys of the restored dune areas will occur each year to document native plant growth and succession patterns and to identify areas where ice plant recolonizes. Recolonized areas will be noted using a GPS unit and reported to the restoration team and DPR staff. As resources are available, qualified field crews will revisit areas where ice plant (*Carpobrotus edulis* and *Carpobrotus chilensis)*, arundo (*Arundo donax)*, or European beach grass (*Ammophila arenaria)* reestablishes and spray or pull the plant as needed.

Approved Herbicide Products

The herbicide products listed in Table 6 may be used for invasive plant control at SRSB. All products will be used in accordance with the product Material Safety Data Sheet (MSDS) and approved California Department of Pesticide Regulation labels. New products will not be added to this list without prior approval.

Table 6. List of potential products used for invasive plant control at SRSB.

Product Name	EPA Reg #
Polaris	228-534
AquaNeat Aquatic Herbicide	228-365-ZA
Inlet	5905-50099-AA
Habitat	241-426-AA- 67690
Roundup Pro Concentrate	524-529
Roundup ProMAX	524-579
Garlon 4 Ultra	62719-527
Milestone	62719-519

Considerations for Special Status Species

WESTER SNOWY PLOVER

The foredune areas will be sprayed outside of the Snowy Plover nesting season (March–September) to ensure breeding plovers are not impacted. Mid and backdune areas may be sprayed or hand weeded year round if approved by DPR and Point Blue partners.

Sand gilia and Monterey spineflower

No spraying will occur in areas where sand gilia and Monterey spineflower are present. In general, sand gilia and Monterey spineflower are associated with more bare sand habitat without dense patches of ice plant (Dorrell and Canepa 1994). Recently developed sand gilia maps (Watson et al. data 2019-2020) will be used to identify locations where herbicide application should not be used. Additionally, locations of special status plant species will be noted during standard vegetation transect surveys and additional special status surveys conducted as part of the restoration monitoring effort (see Appendix B) will be used to further identify locations to avoid use of herbicide. Any ice plant that is found near known Monterey spineflower or sand gilia locations will be hand pulled to protect the special status plants.

GOAL 2. INCREASE NATIVE VEGETATION COVER AND DIVERSITY WITHIN SRSB DUNE SYSTEM

Species Composition Considerations for Planting and Seeding

The overall goal is to achieve a species native cover and diversity most aligned with the local ecology that existed before the introduction of the non-native ice plant. The challenge is the absence of areas free of the invasive ice plant, from which to draw an accurate picture. It is likely, for example, that certain micro-conditions have allowed some native species to exist in the presence of ice plant, while others may have nearly disappeared.

To most effectively achieve the overall goal, the planting of native species each year going forward will balance several factors:

1. Planting the species identified by DPR as best for dune restoration at SRSB (see Table 4, Chapter 2)
2. The results of Phase 1 reference sites (see Chapter 2)
3. Local availability of seeds, re-evaluated in the field each year going forward
4. Observation of the natural recruitment of species, and hence more reliance on the native seed bank.
5. Ongoing evaluation of native plant cover and species diversity, relative to the initial densities and cover estimates provided by DPR (Table 4).

If through ice plant eradication alone the native seed bank is not sufficient to reestablish the native plant community as expected (in line with Phase 1 native plant recovery trajectory), then supplemental planting and seeding will occur to increase cover and/or diversity of native plants. Planting and seeding is expected to be required in at least some amount in most areas, however the density and species of plants needed will vary depending on the location within the dunes.

Objectives

- **Objective 2.1:** Within 5 years of initial treatment for a given restoration areas, establish dunes with more than 50% absolute native cover in order to minimize dune erosion, support natural dune formation processes, and reduce ice plant recolonization.
    - Success Criteria 2.1.1. Absolute cover of native vegetation is more than 50% throughout the restoration area(s)
- **Objective 2.2**: Within 5 years of initial treatment, establish a species composition similar to or better than sections of the dunes restored in Phase 1. Success is measured by two criteria:
    - Success Criteria 2.2.1. Native species diversity is similar or better than reference sections throughout the restoration area(s)
    - Success Criteria 2.2.2. Document presence of 90% of species listed on the State Parks species list (Table 4).

Restoration Actions

Seed Collection (Action to meet Objectives 2.1 and 2.2)

Trained botanists and restoration crew members will collect seeds of native species listed in Table 4 from within the SRSB dunes complex to ensure local genetic diversity is supported. Seed will be collected under the supervision of a restoration biologist by permission from DPR. Maximum genetic diversity shall be assured by collecting seed from un-restored sections of the nearby dunes, and by gathering from as many different plants of the same species as possible. No more than 10% of the produced seed from any one plant shall be collected. Seeds will be collected in the fall and stored until early spring when the seeds will be broadcast within the dune focus areas or sown in the greenhouse for propagation and future out planting. Seed will be collected each year for propagation when needed and out planting during the fall/winter planting season. Seeds from sand gilia and Monterey spineflower will not be collected.

Dune Grass Rhizome Collection (Action to meet Objectives 2.1 and 2.2)

Native dune grass planting is most successful using small plugs generated from segmenting adult plants. Local dune grasses will be collected in small numbers and planted in a greenhouse to generate an adult population from which to establish rhizome plugs for out planting.

Broadcast Seeding (Action to meet Objectives 2.1 and 2.2)

Where native recruitment is less successful, broadcast seeding may be used in addition to native planting. Two seed mixes will be created, corresponding to the species diversity of the fore or mid-to-rear dunes in reference areas. Examples of the seed mixes are shown in Table 7. The quantity of seed needed and exact species will be determined on a case by case basis depending on native recruitment and the target vegetation community structure. The field crew will hand broadcast the seeds in areas where the sand is relatively stable and some native vegetation is present. Broadcast seeding is an effective way to help reclaim pathways and bare areas on the foredune. Further broadcast seeding may be feasible where sprayed ice plant has been decomposing for over one year. Broadcast seeding will be done prior to the first rains (Nov–Jan). Seed may also be broadcast and raked into barren back dune areas if seed supply is available and if seeding the area is

not expected to negatively impact snowy plover breeding habitat or sand gilia habitat per DPR and Point Blue guidance. Seed will be spread by hand onto the sand or fully decomposed ice plant litter and raked in lightly.

Table 7. Example SRSB seed mixes

Location	Seed Mix Species
Foredune	*Ambrosia chamissonis, Armeria maritima, Artemisia pycnocephala, Atriplex leucophylla, Eriogonum latifolium, Eschscholzia californica maritima, Lathyrus littoralis*
Mid-dune	*Abronia umbellata, Armeria maritima, Artemisia pycnocephala, Calystegia solanella, Cardionema ramosissimum, Castilleja latifolia, Chorizanthe pungens ssp. pungens, Dudleya caespitosa, Ericameria ericoides, Eriogonum latifolium, Eriophyllum staechadifolium, Eschscholzia californica maritima, Phacelia ramosissima*

Dune Plant Propagation (Action to meet Objectives 2.1 and 2.2)

Dune plant species from the DPR-approved list (Table 4) will be collected from within the SRSB dune complex for propagation. Quantities of individual plants of each species will be grown and out planted in numbers to reestablish the expected diversity and density (found in reference areas). The use of perlite soil amendment for seed propagation will help reduce soil compaction, lower water retention and increase the permeability, which is characteristic of the soil type found within coastal dunes. Depending on the species, propagation will begin between winter and spring to allow for seedlings to grow large enough to be out planted in late fall (Nov/Dec) prior to first rains. Consistent watering, thinning to one seedling per cell, and the prevention of herbivory are all essential for the survival and health of the dune seedlings while they are grown in the greenhouse.

1. **From seed**
   Seeds will be propagated in 3" deep trays with a mixture of perlite and top soil or potting soil. Once seedlings have germinated they will be transplanted into 2" pots within a soil/sand mix and grown out.

2. **From plant material (rhizomes)**
   Leymus mollis will be propagated/divided from parent material/cuttings taken from approved locations within the SRSB dune complex. Cuttings will be planted in 2" pots. Recommended spacing between plants is 18" and 36" between strip rows.

Native Species Out-planting (Action to meet Objectives 2.1 and 2.2)

1. **Ice plant mulch and native planting**
   Desiccated ice plant material will be present throughout the dunes after the herbicide spraying (approximately 4–9 months after initial application). This mulch material provides enhanced conditions for survival of planted juvenile native species. The mulch layer provides insulation from

extreme soil temperature fluctuations, retains dune moisture, inhibits weed colonization and can enhance fog condensation (D'Antonio 1990, Magnoli 2013). A four-inch spade will be used to cut through the ice plant mulch and juvenile native plants will be planted. Sand and mulch will be laid around the plant and water will be applied. Plants will be placed at distances of 6 to 18 inches apart, dependent on the expected width of a one-year-old plant. Several studies have found that ice plant removal areas (with and without the presence of ice plant mulch) can enhance invasive, non-native annual grass recruitment (Magnoli 2013). Invasive annual grasses are not a problem within SRSB and therefore not a significant concern. Surveys will be completed to ensure that invasive grasses do not become a problem.

2. **Planting on bare sand**
   Some native plants will be planted in foredune areas where no plants currently exist. In these areas, plants will be planted within small mounds (3" high) above the base elevation to reduce burial. Plant spacing in this area will be determined in close consultation with DPR and Point Blue to ensure that snowy plover breeding habitat is not negatively impacted.

3. **Planting in straw bales**
   Straw bales may be placed in low density in areas where excessive human trampling has led to a degradation of dune contours. Straw bales will be placed at low density to encourage rebuilding of foredune habitat that replicates natural topographic variability (see Goal 3 Actions). Native foredune plants (i.e. *Leymus*) will be planted within and adjacent to the bales to stabilize the structures and increase foredune roughness and stability.

4. **Watering**
   All greenhouse reared plants will be out-planted in the late fall, scheduled to coincide with first rains.

GOAL 3. ENHANCE STORM RESILIENCE OF SRSB DUNE SYSTEM

Increasing Erosive Resistance of Dunes

Several studies have documented the increased vulnerabilities to wave impacts posed by ice plant invasion on native dune systems. Sand dune vegetation plays a primary role in dune stabilization (De Lillis, 2004), and the loss of plant species that trap sand makes the beach more vulnerable to wind and wave derived erosion. In areas open to direct winter wave action, waves can impact the steep edges of ice plant hardened fore-dunes causing undercutting beneath the plant biomass, washing away underlying sands below the shallow root zone, leading to catastrophic failure. In contrast, native dune species of the central Monterey Bay establish deep root matrixes that provide a three dimensional lattice of roots and mycorrhizae that resists wave and wind erosion and support vertical plant growth in step with dune formation (Dorrell-Canepa 2005).

The restoration of coastal dune systems can help inhibit coastal erosion. Removal of exotic iceplant species (*C. edulis and C. chilensis*) can lead to an increase in native dune species and to the re-establishment of a more

dynamic foredune community. Such restoration has been recommended as an initial response to projected dune erosion from sea level rise and helps to maintain natural coastlines and dune systems at far less expense than coastal armoring (De Lillis et al. 2004, Langridge et al. 2014)

Several studies suggest that restoring the complexity of dune species (De Lillis et al. 2004) and the reestablishment of native foredunes can aid the long term resiliency of dunes to wave derived erosion. This structural complexity is anticipated to play a key role in maintaining resilience as ocean levels rise and dunes are required to adapt and migrate. This project anticipates and will study how the removal of *C. edulis* and *C. chilensis* and the replanting of native foredunes species enhance foredune stability and resilience due to storm induced wave impacts; that will intensify as ocean levels rise.

Key Causes of Foredune Failure

Three key processes that lead to foredune failure will be ameliorated through removal of ice plant and reintroduction of native species.

1. **Catastrophic dune edge collapse**
   Foredunes dominated by ice plant capture and retain sand while forming a dense canopy and a steep dune face. While these dune edges (usually located above high water line) may be resistant to average wave patterns, wave impacts during large storm events can hit the dune edge with significant force, washing sand from below the ice plant canopy, resulting in mass wasting events and the loss of all plant material on the face of the fore dune.

2. **Increase in wave run up energy**
   Foredunes edges dominated by ice plant often are devoid of plant material between the foredune edge and the water. The steeper ice plant dominated foredune fails to reduce wave runup energy as is common from gradually sloped foredune with sparse native plants that provide foredune roughness and protection provided by the deep root systems of the native plants. Restoration of sparse and diverse foredune species will reduce wave runup energy through increased roughness and a more gradual foredune slope.

3. **Reduced vigor of native species**
   Several studies have documented the impacts on native dune plants in the vicinity of ice plant due to subsurface competitive interactions that lead to stunted growth of native plants (D'Antonio et al. 1991). Both above and below ground biomass of native species is reduced leading to less efficient accumulation of sand and reduced subsurface root biomass and dune structure (D'Antonio et al. 1991, Jucker 2013).

Objectives

Objective 3.1: Within 10 years of restoration initiation, reduce wave runup energy by decreasing slope of foredune face compared to pre-restoration topographic surveys or areas where restoration activities were not conducted (control areas).

- Success Criteria 3.1.1. Documented decrease in foredune slope compared to pre-restoration topographic surveys and in areas where restoration activities were not conducted.
- Success Criteria 3.1.2. Decrease in foredune collapse event areas

Objective 3.2. Within 10 years, enhance foredune topography roughness to dissipate wave energy and reduce erosive impacts of waves on foredune.

- Success Criteria 3.2.1. Increased foredune topography roughness from pre restoration topographic surveys
- Success Criteria 3.2.2. Increase in foredune area populated with native dune grass.

Objective 3.3 Eliminate unsanctioned perpendicular access ways, or realign access ways, to reduce dune-scar created wave ramps that funnel wave run-up energy and potential dune overtopping.

- Success Criteria 3.3.1. Reduced number, or realignment of perpendicular access ways from pre-restoration number.

Restoration Actions

Use Driftwood, Straw Bales, or Decomposing Drift Fencing to Enhance Structural Integrity of Foredune (Action to meet Objective 3.1, 3.2, 3.3)

Opportunistic reuse of driftwood accrued within SRSB during winter storms, straw bales, or decomposing drift fencing may be placed sparsely in areas along the foredune where dunes are steep or where previous wave erosion scars are evident. These structural features will be placed in low density to encourage sand deposition, increase foredune roughness, eliminate wave run up ramps, and provide three-dimensional stability as native species reestablish*. Driftwood will not be used as an alternative to coastal hardening.

Native Planting along Foredune (Action to meet Objectives 3.1, 3.2, 3.3)

Native plantings of dune grass (*Leymus mollis*) and beach bur (*Ambrosia chamissonis*) will be placed along the foredune to encourage low density reestablishment of native species and foredune topographic complexity. Native species will be planted within areas where ice plant was removed. Planting will include planting of straw bales and around driftwood to help stabilize these accretion structures.

Native Planting Within Dune Scars (Action to meet Objective 3.3)

Planting of native fore and mid dune species will occur within dune scars to help eliminate unsanctioned perpendicular access ways.

OPPORTUNISTIC SAND PLACEMENT (ACTION TO MEET OBJECTIVE 3.1, 3.2, 3.3)

Opportunistic sand placement will continue to be discussed with Monterey County to investigate future use of sand removed to breach the Salinas River lagoon. Similar discussions are ongoing with the Moss Landing Harbor District.

*Note: All area-specific planting and the use and placement of drift wood, straw bales, or decomposing fencing will be reviewed and approved by DPR (or private land owner) and Point Blue in advance of plantings.

GOAL 4. SUPPORT DUNE MANAGEMENT EFFORTS OF DPR

Objectives

- **OBJECTIVE 4.1**. Improve trail system at SRSB through upgrades to fencing, maintenance of trails, and enhancement of interpretive signage at access points and along trails.
- **OBJECTIVE 4.2**. Support DPR in Ongoing Maintenance
- **OBJECTIVE 4.3**. Support State Parks in Dune Monitoring

Restoration Actions

IMPROVE TRAIL SYSTEM (ACTION TO MEET OBJECTIVE 4.1)

1. **Upgrade or Install New Fencing**
   SRSB has approximately 7,000 feet of existing trails in the dune system. With direction from DPR, dune habitat management efforts will include installation of, or upgrades to, post and cable and no-climb fencing (or a similar type of fencing) at access points and priority trails in order to protect sensitive habitat, reduce erosion caused by wayward foot and vehicle traffic, and to delineate public access corridors to the beach. DPR has prioritized fencing needs at the Molera Road and Sandholdt Road access points, as well as along the back dune trail, where wayward trails are most abundant (see Figure 14 for trail and public access locations). Specific locations to install new or upgrade existing fencing include along both sides of the trail from the Molera parking lot to the beach (1600 feet) and along the private parcel of the back dune trail that runs between the Potrero and Sandholdt parking lots (425 ft). Additional locations for fence installation or upgrades will be determined by DPR. No climb fencing would include a 10" gap between the ground and the base of the fence to allow for passage of lizards and small mammals.

2. **Install Interpretive Signage**
   To enhance visitor appreciation, enjoyment, and knowledge of SRSB and the surrounding dune complex, interpretive signs will be installed at coastal access points and along main dune trails to provide education about sea level rise, dune erosion, habitat restoration, and endangered species (see Figure 14 for access points and trail locations). During Phase 1 of the project, a 3-paneled

kiosk was installed at the Molera Road beach access parking lot, two 2'x3'low profile interpretive signs were installed at the Potrero Road beach access parking lot, and ten "kindly keep off the dunes" regulatory/interpretive signs were installed along beach access trails and along the lateral dune/horse trail. Additional interpretive signs will be installed at the Sandholdt Road beach access parking lot. Please see Figure 15 for design of low-profile and kiosk interpretive signs. If budget permits, additional signs may be placed along the back dune trail or at adjacent dune restoration sites within the greater SRSB dune complex to help inform this community about the sensitive dune habitat and sea level rise. All interpretive sign design and language will be approved by DPR to ensure that signs meet DPR standards. Interpretive signs will be made of a material that resists damage by vandals and the weather. Low profile signs and kiosks will be secured into the ground by concrete footings. No signs will be installed on the beach. Additional temporary signs prohibiting entry into restoration may read "Restoration in progress- Please Do Not Enter" and will be placed at the edges of the restoration areas.

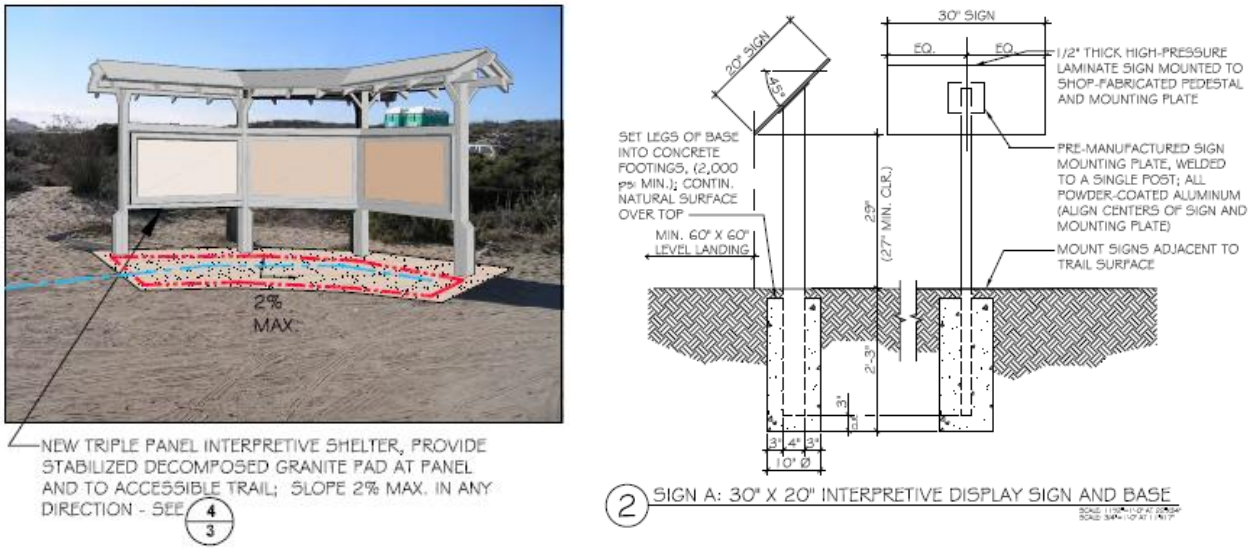

Figure 15. Sample kiosk and low-profile designs for interpretive signage

3. Remove Dilapidated Boardwalk

Additional trail improvement work may include the removal of the dilapidated boardwalk at the Molera Road beach access (Figure 16). At this location, the beach access trail forks approximately 50 feet west of the parking lot. The northern fork of the trail has an unimproved, bare-sand surface, and intersects with the south end of the lateral dune/horse trail before reaching the beach. The dilapidated boardwalk covers the surface of the majority of the southern fork of the beach access trail. The forks of the trail end at the beach approximately 275 feet apart from each other. The boardwalk on the southern fork of the trail is in a state of disrepair with loose, missing, and uneven boards throughout its length. In its current condition, it presents a tripping hazard to trail users.

The purpose of the two trail forks was to provide pedestrians with an improved trail surface (a boardwalk) and allow equestrian access on an unimproved surface because the boardwalk would not withstand equestrian traffic. Without a functional boardwalk, the two forks are redundant. This work would remove the dilapidated boardwalk and its associated hazards and permanently close the approximately 685-foot southern fork of the trail. Approximately 400 feet of boardwalk remains and will be removed by hand and/or with the use of small equipment that will fit on the surface of the trail without impacting the adjacent dune vegetation. Fencing and signage will be installed at both ends of the south fork to close the trail and direct pedestrians to the open, north fork of the trail. After the boardwalk has been removed, the sand surface will be seeded with local native seed and allowed to revegetate. If the area is not obviously revegetating after one year, native plants will be propagated and planted along the former trail surface. Invasive exotic plants will be controlled as needed.

SUPPORT PARKS IN ONGOING MAINTENANCE EFFORTS (ACTION TO MEET OBJECTIVE 4.2)

Ongoing natural resource maintenance at the SRSB dune complex will include invasive plant control revegetation of user-created trails, native planting in defined dune restoration areas, dune/vegetation protection, and western snowy plover protection and management throughout the dune complex. Invasive plant control will include control of ice plant (*Carpobrotus edulis* and *Carpobrotus chilensis*), slender ice plant (*Conicosia pugioniformis*), European dune grass (*Ammophila arenaria*), arundo (*Arundo donax*), bridal creeper (*Asparagus asparagoides*), and more, including new infestations of species previously unknown to the SRSB park unit. Invasive plant control methods will include manual pulling and approved herbicide application techniques. These maintenance efforts are and will continue to be limited by available funding. Maintenance efforts will be conducted in coordination with project partners such as DPR, Central Coast Wetlands Group, Coastal Conservation and Research, Moss Landing Marine Labs, Point Blue, Return of the Natives, and the California Conservation Corps to continue to meet Goals 1 and 2 of this Plan, stated above. Restoration areas and sensitive species areas (e.g. sand gilia sites) will be considered high priority areas to focus invasive plant control and vegetation protection efforts.

IMPLEMENT DUNE RESTORATION MONITORING PROGRAM (ACTION TO MEET OBJECTIVE 4.3)

Periodic monitoring efforts will be completed to quantify native species abundance and diversity, track changes in dune topography and identify and address recolonization by ice plant. These monitoring efforts will help inform DPR on future management of the dune system (see Appendix B for the monitoring program).

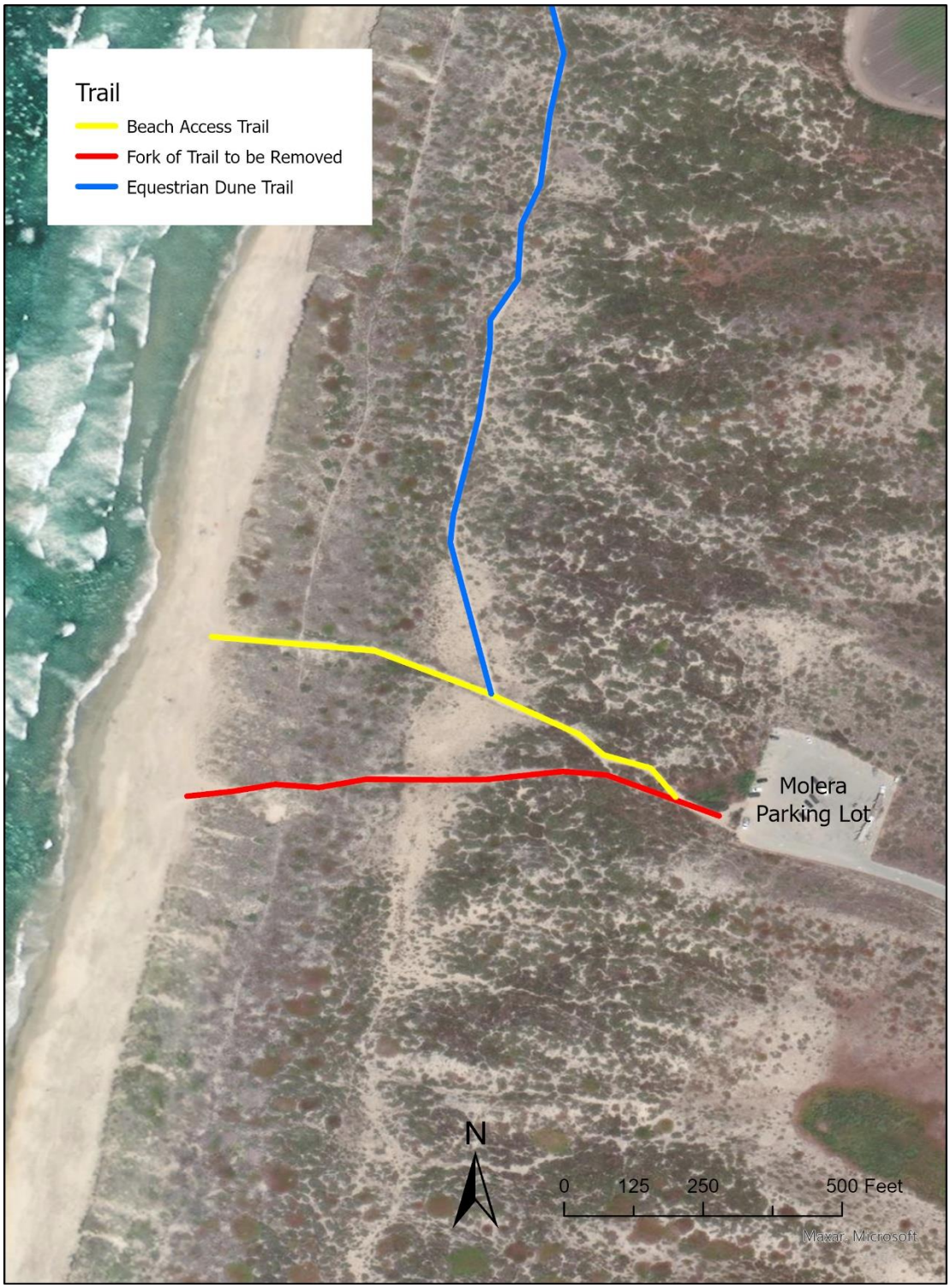

Figure 16. Molera access boardwalk and redundant trail removal project site map. The southern fork will be removed and the north fork will be enhanced to provide superior and safe access to the beach. Similar main trail enhancement projects at other locations will be coordinated and implemented in partnership with DPR as described within this Restoration Plan.

Avoidance Measures

All sensitive species and their habitats were evaluated for potential impacts by this project (Appendix A). Any potential impacts to native animal species are likely to be minimal and temporary, while the benefits are expected to endure. Project guidelines were developed in partnership with DPR staff during Phase 1 and will continue to be implemented to avoid, reduce, or mitigate impacts (to a less than significant level) to the native fauna including the sensitive and special status species.

The sparsely vegetated foredunes, beach and river mouth area of SRSB provide important breeding habitat for the western snowy plover. The snowy plover breeding season occurs from March 1 to September 30 each year. No project activities will be scheduled within the breeding habitat (See Figure 4) during the breeding season. Some project activity may be conducted in the mid to rear dune coastal scrub during the plover breeding season, but only at the discretion of DPR biologists in consultation with Point Blue ecologists.

Because this project proposes to install native vegetation in sparsely vegetated areas, it will be important not to decrease the amount or quality of breeding habitat available for western snowy plovers at SRSB. Area-specific planting plans and the use of straw bales will be reviewed and approved by DPR and Point Blue biologists in advance of plantings. Plans will be modified if they appear to negatively alter plover habitat. Additionally, plants may be removed if important breeding areas are inadvertently planted too densely.

For a complete list of avoidance measures and project requirements please see Appendix A.

Prioritized Areas for Restoration

Currently, restoration efforts at SRSB are being conducted with available grant funding. Figure 17 shows how dune areas have been prioritized for restoration within this Plan. The map shows locations of Phase 1 efforts as well as priority locations for future restoration. Because this ongoing work is funded through competitive grant awards which focus on specific and unique environmental objectives, we must use our habitat inventory and GIS mapping to select sections of the dunes to restore that where possible 1) best meet the goals of the funding announcement, 2) help to expand the consecutive footprint of the restoration effort to minimize edge effects that can lead to reintroduction of ice plant, 3) support the management goals of State Parks (special status species management, visitor access management, and 4) benefit the local community and support research investigations of CCWG, MLML and CSUMB researchers.

Phase 1

Phase 1 areas (blue) were prioritized because these areas were identified as being impacted by winter waves and unsanctioned/mismanaged pathways and were narrow sections of the dunes that were most vulnerable to wave erosion and overtopping, leading to inland flooding of the Salinas Valley. Funding was provided to increase dune stability/resiliency and enhance dune habitat to ensure the dune system remains a viable natural boundary between the low-lying Salinas Valley and winter waves.

High Priority

The dune section located between the northern boundary of SRSB and the Potrero Access has been identified as a high priority restoration area because it helps link previous restoration areas together into a large natural complex, and provide valuable habitat for snowy plovers and other dune species. This section of dunes is relatively narrow (about 75 meters in width) and is heavily covered by ice plant. Funding from CDFW (Environmental Enhancement Fund grant provided in 2020) has been secured to restore this section of dunes.

Mid Priority

This dune section was a lesser priority because of its size, distance from public foot traffic, and relative width that provides longer term protection to the Salinas Valley. As funding is made available, this area will be the next to be integrated with other high priority areas.

Low Priority

This dune section is far from wave impacts and thus less susceptible to coastal erosion. Leaving this dune area covered in ice plant does increase boundary length between restored and unrestored areas that will continue to make maintenance of ice plant recolonization within restored areas challenging. As funding becomes available, this area will be elevated for treatment with other high priority areas.

Private Parcel

The privately owned parcel sandwiched between SRSB land to the north and south is in the process of being purchased and transferred to a land conservation organization. Once this occurs, this parcel will be included as a high priority restoration area.

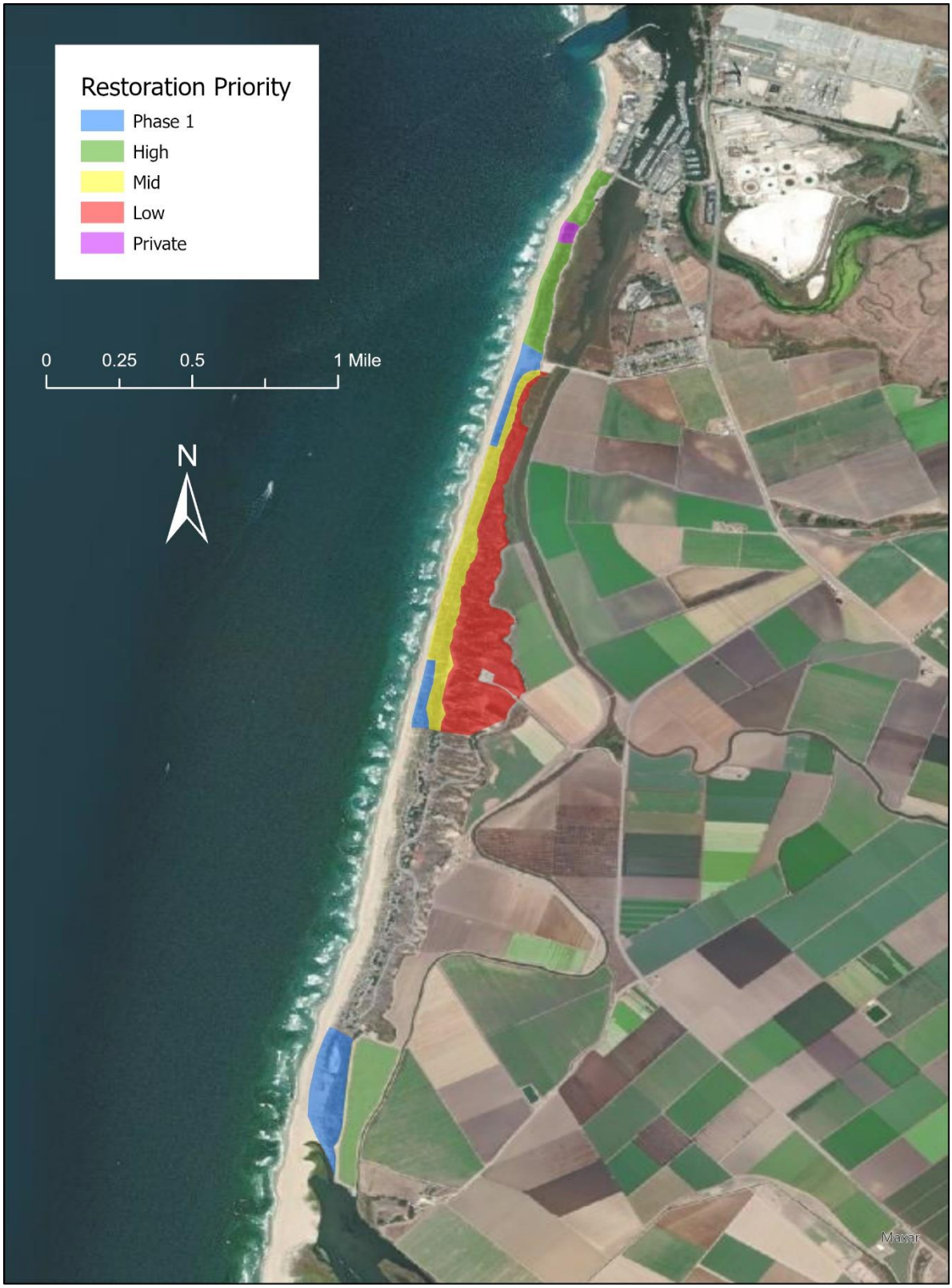

Figure 17. Restoration Priority Areas

Salinas River State Beach Dune Monitoring Program

Eradication of invasive ice plant and the restoration of native plants has been shown to benefit native animal species including western snowy plover, legless lizard, Smith's blue butterfly (Dorrell-Canepa. 2005). As part of our ongoing dune restoration efforts, CCWG and partners will conduct plant, animal and topographic surveys of the dunes to monitor and document restoration success. Research questions will investigate how species of interest may respond (through increases in abundance and distribution) to reduction in ice plant cover and reestablishment of native plant species. **Appendix B** describes the monitoring protocols used for this monitoring program.

Data Sharing

Project updates, annual monitoring data and summary reports, and final grant deliverables will be provided to partner organizations and agencies and made available for download on the CCWG website.

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APPENDIX A:
PROJECT REQUIREMENTS & AVOIDANCE MEASURES

PROJECT REQUIREMENTS

Under CEQA, the California Department of Parks and Recreation (DPR) has the distinction of being considered a lead agency, a public agency that has the primary responsibility for carrying out or approving a project and for implementing CEQA. During development of the Phase 1 SRSB Dune Restoration Project in 2015, the project team, in coordination with DPR, compiled a list of project requirements for DPR's Project Evaluation process, (DPR form 183), a process in which DPR initiates environmental review of a project and determines potential impacts. The list of project requirements has been updated to reflect the most recent version of the Restoration Plan.

Aesthetics

1. Projects will be designed to incorporate appropriate park scenic & aesthetic values including signage and fencing materials and colors and development of appropriate revegetation using native plants. The park scenic and aesthetic values will also consider views into the park from neighboring properties.
2. CCWG and CCR will store all project-related materials outside of the viewshed of SRSB.

Air Quality

1. All trucks or light equipment hauling soil, sand, or other loose materials on public roads will be covered or required to maintain at least two feet of freeboard.
2. All gasoline-powered equipment will be maintained according to manufacturer's specifications, and in compliance with all State and federal requirements.

Biological Resources

1. Plants and plant communities – Menzies' wallflower, Monterey gilia, Monterey spineflower, sand-loving wallflower, central dune scrub plant community, northern coastal salt marsh plant community
    a. All personnel engaged in restoration activities with the potential to harm special status plants and plant communities will be instructed by the project manager or a DPR-approved biological monitor in the identification of such special status plants and plant communities and how to avoid them.
    b. Special status plant and plant community distributions were mapped using the CNDDB (CDFW 2019) and other special status plant maps (Watson et al. data 2019-2020). Prior to work in project sites that overlap with special status plant and plant community distributions, special status plant and plant community boundaries will be identified in the field at the beginning of the work day and instruction on how to operate in these areas to avoid plants and plant communities will be given to workers.

c. If special status plants and plant communities listed in (1) above are located within 100 ft feet of the project area, they will be flagged by the project manager or biological monitor prior to the start of restoration activities, and completely avoided.

d. No herbicide will be used within 50 ft of special status plants.

e. Care will be given to ensure that root systems of special status plants and plant communities are not dislodged where invasive plants are hand-pulled.

f. To maintain genetic integrity, only plant stock collected within the SRSB will be used for revegetation in the project area.

g. All herbicides will be handled, applied, and disposed of in accordance with the MSDS Fact Sheet and all local, state, and federal laws.

h. CCWG and CCR will employ Best Management Practices (BMPs) for erosion control to avoid runoff of project-related sediments, tool or vehicle fluids, and other liquids into special plant communities.

2. Wildlife – invertebrates, including globose dune beetle

   a. The project manager or DPR-approved biological monitor will relocate any globose dune beetles encountered during ground-disturbing activities into adjacent, suitable habitat.

3. Wildlife – fish, including tidewater goby

   a. Ponds, lagoons, and wetland areas will not be used as equipment staging or refueling areas. Equipment will be stored, serviced, and fueled away from ponds, lagoons, and wetland areas.

   b. Erosion control measures to prevent sedimentation will include leaving herbicide treated invasive species in place to help stabilize dunes while native plants are growing and may include the use of straw bales (after review and approval by DPR and Point Blue biologists) in advance of plantings.

4. Wildlife – amphibians and reptiles, including legless lizard

   a. Project personnel will be instructed by the project manager or a DPR-approved biological monitor regarding the life history and habitat requirements of legless lizards and other amphibians and reptiles, and instruction in the appropriate protocol to follow in the event that a legless lizard or other amphibian or reptile is found on site.

   b. In the event that a legless lizard or other amphibian or reptile is found during project activities, work in the vicinity of the animal will be delayed until the organism moves out of the site of its own accord, or is temporarily relocated to nearby suitable habitat by the project manager or other DPR-approved personnel.

5. Wildlife – birds, including short-eared owls

   a. The project manager will schedule all work between October 1 and February 28 each year to avoid nesting season for birds including short-eared owls.

b. If work is required during the nesting season on the mid or rear dune, the project manager or a DPR-approved biological monitor will survey the project areas and surrounding habitats for nesting birds within 7 days prior to the start of onsite work. Work in this location will be performed at the discretion of DPR biologists in consultation with Point Blue ecologists.

c. If nesting raptors, including short-eared owls, are found in the project area, no onsite activities will occur within a 500 ft. radius of the nest location between March 1 and September 30, or until the young have fledged and the young would no longer be impacted by project activities, as determined by the DPR-approved biologist, and there is no evidence of a second attempt at nesting.

d. If nesting migratory birds are found in the mid or rear dune, no onsite activities will occur within a 300 ft radius of the nest location between March 1 and September 30, or until the young have fledged and the young will no longer be impacted by project activities, as determined by the DPR-approved biologist.

6. Wildlife – Western snowy plovers

a. No project activities will be scheduled in western snowy plover breeding habitat during breeding season, March 1 to September 30.

b. Outside of the breeding season, if vehicles or mechanized equipment are used on the beach or dunes, each day prior to the start of project work, all areas within 1000 ft of project activities will be surveyed for the presence of snowy plovers. The first survey will be conducted the day before the start of the project. Surveys will be conducted by DPR or Point Blue staff.

c. If vehicles or mechanized equipment are used on the beach or dunes and plovers are not seen in the survey area, the project manager will be given direction to proceed, with the condition that a plover surveyor be present to monitor the project while it is ongoing if Point Blue ecologists or DPR biologists deem it necessary.

d. If vehicles or mechanized equipment are used on the beach or dunes and plovers are seen within 660 ft of the work area, plover behavior will be monitored by the plover surveyor, and activities in that area will be cancelled if plover behavior is affected. Work will resume the next day, and another survey will be conducted. If plovers are seen on the second survey but no nest is found, and breeding behavior is not observed, the project activities will proceed at the discretion of the plover surveyor.

e. Plover surveyors will be responsible for directing the project manager to stop or modify activities if plovers exhibit disturbance behavior that is related to the project activity.

f. If at any time a nest or brood is located near enough to project activities that bird behavior is affected, project work in that area will be cancelled until the end of the breeding season or until further monitoring activities document that the nest is no longer active or the broods have moved out of the area.

g. Project work, including operation of vehicles, will occur no earlier than ½ hour after sunrise and conclude at least ½ before sunset.

h. DPR may consult with USFWS or Point Blue ecologists and request technical assistance for site-specific avoidance or mitigation measures. Any such changes will be amended into the Mitigated Negative Declaration if necessary.

7. Wildlife – Salinas harvest mouse

   a. Project work, including operation of vehicles, will occur no earlier than ½ hour after sunrise and conclude at least ½ before sunset.

   b. Immediately prior to the start of work each morning the project manager or a DPR-approved biological monitor will conduct a visual inspection of the project zone where activities will take place.

   c. In the event that a Salinas harvest mouse is found on the project site, work in the vicinity of the animal will be delayed until the organism moves out of the site of its own accord, or is temporarily relocated by the project manager or other DPR-approved personnel.

Cultural and Tribal Cultural Resources

1. Prior to the start of construction, a DPR archaeologist will consult with the contractor and project manager to identify all resources that must be protected.
2. No track-mounted or heavy-wheeled vehicles will be allowed in identified areas with cultural resources. If foot traffic is necessary, this will only be allowed with specific permission from the DPR's Representative after clearance with the project manager.
3. Prior to the start of construction, a DPR cultural resources specialist or their designee will train project personnel in cultural resource identification and protection procedures.
4. Any locations where ground disturbing activities are proposed for the removal of invasive plant species or the installation of fencing and signage will require additional archaeological review. This will include archival research and/or possible field investigations to identify previously undocumented archaeological resources in specified treatment areas.
5. A DPR archaeologist familiar with the project will review and authorize all vehicle and equipment staging and material storage sites except those staging/storage locations situated on the currently paved surface of the parking lots or those locations outside of the park.
6. If a contractor, project manager, or other staff member discovers previously undocumented cultural resources during project construction work within 82 ft of the find will be temporarily halted until the archaeologist designs and implements appropriate treatments in accordance with the Secretary of the Interiors Standards and Guidelines for archaeological resource protection.

a. The project manager working with the DPR archaeologist will modify the project to ensure that construction activities will avoid cultural resources upon review and approval of the DPR archaeologist.

b. If ground disturbing activities uncover intact cultural features (including but not limited to dark soil containing shellfish, bone, flaked stone, groundstone, or deposits of historic ash), when a DPR Qualified cultural resources specialist is not on-site, the project manager will contact the DPR State Representative immediately and will temporarily halt or divert work within the immediate vicinity of the find until a DPR-qualified cultural resources specialist evaluates the find and determines the appropriate treatment and disposition of the cultural resource.

7. In the event that human remains are discovered, work will cease immediately in the area of the find and the project manager/site supervisor will notify the appropriate DPR personnel. Any human remains and/or funerary objects will be left in place or returned to the point of discovery and covered with soil. The DPR Sector Superintendent (or authorized representative) will notify the County Coroner, in accordance with §7050.5 of the California Health and Safety Code, and the Native American Heritage Commission (or Tribal Representative). If a Native American monitor is on-site at the time of the discovery, the monitor will be responsible for notifying the appropriate Native American authorities.
8. The local County Coroner will make the determination of whether the human bone is of Native American origin.
9. If the Coroner determines the remains represent Native American interment, the NAHC in Sacramento and/or tribe will be consulted to identify the most likely descendants and appropriate disposition of the remains. Work will not resume in the area of the find until proper disposition is complete (PRC §5097.98). No human remains or funerary objects will be cleaned, photographed, analyzed, or removed from the site prior to determination.
10. If it is determined the find indicates a sacred or religious site, the site will be avoided to the maximum extent practicable. Formal consultation with the State Historic Preservation Office and review by the Native American Heritage Commission/Tribal Cultural representatives will occur as necessary to define additional site mitigation or future restrictions.

Geology/Soils

1. CCWG, CCR and DPR will decommission volunteer trails in the dunes by replanting native plants and shrubs in the volunteer trails
2. CCWG and CCR will clearly block both ends of volunteer trails with native plants to discourage continued use and degradation of the decommissioned volunteer trails.

Hazards and Hazardous Materials

1. Prior to the start of on-site construction activities, the project manager will inspect all equipment for leaks and regularly inspect thereafter until equipment is removed from the project site. All contaminated water, sludge, spill residue, or other hazardous compounds will be contained and disposed of outside the boundaries of the site, at a lawfully permitted or authorized destination.
2. If necessary, a Spill Prevention and Control Plan (SPCP) will be prepared prior to the start of the project and an appropriate spill kit maintained onsite throughout the duration of the project. The SPCC Plan will include a map delineating project staging or storage areas and areas where refueling, lubrication, and maintenance of equipment may occur. In the event of a spill or release of any chemical on or adjacent to the project site, the contractor or equipment operator will immediately notify appropriate DPR staff and implement the Monterey County Hazardous Materials Incident Response Plan. Appropriate agencies will be notified in the event of significant spillage.
3. If necessary, prior to the start of construction, CCWG and CCR will develop a Fire Safety Plan for DPR approval. The plan will include the emergency calling procedures for both the California Department of Forestry and Fire Protection (CAL FIRE) and local fire department(s).
4. Prior to the start of on-site construction activities, CCWG, CCR, and contractors will clean and repair (other than emergency repairs) all equipment outside the project site boundaries.
5. The project manager will designate and/or locate staging and stockpile areas within the parking lots to prevent leakage of oil, hydraulic fluids, etc. into native vegetation, ponds, the Salinas River Lagoon, or the old Salinas River Channel.
6. When not in use, hazardous materials will be stored in a locked storage area. Materials will be transported to the work site in spill proof containers and will be secured in the vehicle so as to prevent spillage.
7. All heavy equipment must be equipped with spark arrestors or turbo-charging (eliminates sparks in exhaust). At the end of each workday, heavy equipment must be parked over asphalt or concrete to reduce chance of fire. If no local asphalt or concrete is available, heavy equipment shall be parked over bare ground with drip pans to inhibit petroleum discharges to soil.
8. Restoration crews must park vehicles away from flammable material, such as dry grass or brush.
9. All internal combustion engines used for any purpose at the job site must be equipped with a muffler of a type recommended by the manufacturer and that all equipment and trucks used for construction utilize the best available noise control techniques (e.g., engine enclosures, acoustically attenuating shields or shrouds, intake silencers, ducts, etc.) whenever feasible and necessary.
10. Personnel must have firefighting hand tools on site and each vehicle shall have an appropriately-sized and fully charged fire extinguisher.
11. No herbicide will be used within 50 ft of special status plants or animals.

12. All herbicides will be handled, applied, and disposed of in accordance with the MSDS Fact Sheet and all local, state, and federal laws.
13. Herbicide spraying will be timed to coincide with the late fall dormancy period of native plants, prior to native seedling germination.
14. Spot-spraying of herbicide will be used within special status plant communities (central dune scrub and northern coastal salt marsh) to eliminate individual, persistent non-native plants.
15. Only handheld, targeted spraying will be done, avoiding spraying during windy or rainy conditions. Spraying will be limited to when winds are no more than 10 mph with extra caution taken when at 5-10 mph, and not within 24h of predicted or observed rainfall, to prevent chemical drift from wind and rain.
16. Sprayed areas will be closed for 24 hours to limit visitor exposure to herbicides.
17. Use will be restricted to the least hazardous herbicides and surfactants that will accomplish the task of killing ice plant and other non-native plants.

Hydrology/Water Quality

1. The project will comply with all applicable water quality standards as specified in the Water Quality Control Plan for the Central Coast Basin. https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/

Land Use/Planning

1. Conditions and requirements identified through the Coastal Development Permit process will be incorporated into the project design and specifications, and implemented as part of the project scope to avoid potential natural resource impacts.

Noise

1. Internal combustion engines used for project implementation will be equipped with a muffler of a type recommended by the manufacturer. Equipment and trucks used for Project-related activities will utilize the best available noise control techniques (e.g., engine enclosures, acoustically attenuating shields or shrouds, intake silencers, ducts, etc.) whenever necessary.
2. The project manager will locate stationary noise sources and staging areas as far from potential sensitive noise receptors, as possible. If they must be located near potential sensitive noise receptors, stationary noise sources will be muffled or shielded, and/or enclosed within temporary sheds.
3. Project activities will be limited to the daylight hours. No work will occur before 7:30 a.m. or after 8 p.m.

SPECIAL STATUS SPECIES AVOIDANCE MEASURES

The following avoidance measures will be implemented during restoration efforts.

Biological Resources

Plants

Plant surveys will be conducted during the bloom season prior to work beginning in project areas so that the locations of any special status plants (Menzies' wallflower, Monterey gilia, Monterey spineflower, sand-loving wallflower) can be flagged and incorporated into a project GIS database. Only hand weeding will occur in the vicinity of flagged plants. Herbicide spraying will be timed to coincide with the late fall dormancy period of native plants, prior to native seedling germination. Spot-spraying of herbicide will be used within special status plant communities (central dune scrub and northern coastal salt marsh) to eliminate individual, persistent non-native plants.

Western snowy plovers

The sparsely vegetated dunes, beach and river mouth area of SRSB provide important breeding habitat for the western snowy plover. The snowy plover breeding season occurs from March 1 to September 30 each year. No project activities will be scheduled within the breeding habitat during the breeding season. Some project activity may be conducted in the mid to rear dune coastal scrub during the plover breeding season, but only at the discretion of DPR biologists and in consultation with Point Blue ecologists.

Because this project proposes to install native vegetation in sparsely vegetated areas, it will be important not to decrease the amount or quality of breeding habitat available for western snowy plovers at SRSB. Area-specific planting plans will be reviewed and approved by DPR and Point Blue biologists in advance of plantings. Plans will be altered if they appear to significantly alter plover habitat. Additionally, plants may be removed if important breeding areas are inadvertently planted too densely.

Other nesting special status birds

Onsite weeding, planting, and fence building activities will be largely scheduled during the non-breeding season, October 1 to February 28 each year. If onsite activities must be scheduled on the mid to rear foredune during the short-eared owl breeding seasons, March 1 to September 30, a DPR-approved biologist will conduct surveys at project sites for nesting bird presence within 3 days prior to the start of onsite work under the following conditions:

- Raptors: if nesting raptors are found, no onsite activities shall occur within a 500 ft radius of the nest location between March 1 and September 30, or until the young have fledged and the young would no longer be impacted by project activities, as determined by the DPR-approved biologist, and there is no evidence of a second attempt at nesting.
- Migratory birds: if active nests are located, no onsite activities shall occur within a 300 ft radius of the nest location between March 1 and September 30, or until the young have fledged and the

young will no longer be impacted by project activities, as determined by the DPR-approved biologist.

APPENDIX B: MONITORING PROGRAM

Abstract

The project team will conduct flora, fauna, and topographic surveys at Salinas River State Beach (SRSB) to investigate the effects of dune restoration on native plant cover and diversity, distribution and abundance of special status species, and dune morphology. Periodic plant surveys (native, non-native, and special status), legless lizard surveys, and dune topographic monitoring efforts will be completed to quantify native species abundance and diversity, track changes in dune topography and identify and address recolonization by ice plant. Surveys will be completed by trained researchers and any surveys in the foredune area will be conducted outside of Snowy Plover nesting season, unless otherwise approved by DPR staff. This monitoring program is currently approved under a DPR Scientific Research and Collections Permit (Permit 720-4821-005, issued April 8, 2021, expires March 31, 2022). The project team will renew the permit each year during the project for ongoing monitoring.

Introduction

The dune system at Salinas River State Beach (SRSB) has been disrupted by the introduction of ice plant (*Carpobrotus edulis* and *Carpobrotus chilensis*). The California Invasive Plant Council (Cal-IPC) classifies the impact of *Carpobrotus edulis* (Hottentot-fig) on native ecosystems as *high and Carpobrotus chilensis* (sea fig) as *moderate,* however, the two species are known to hybridize in the region and can be difficult to distinguish so it is conservative to treat all as highly invasive. Species with a *high* rating have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure and their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment (Cal-IPC 2006). Ice plant establishes a dense cover of plant material that eliminates open dune space and impedes recruitment of native species, especially species that require periodic disturbance for recruitment (D'Antonio and Mahall 1991). The degradation of dune habitat by invasive species is not only detrimental to the native flora and fauna of the dunes but it also undermines the dune's capacity to act as protective barrier to inland resources from large storms and sea level rise. Vegetation patterns within the dunes are strongly correlated with dune morphology (Pickart 1998). Studies suggest that the removal of ice plant and reestablishment of native species will enable dune complexes to better respond to wave impacts, which will enable them to be more resilient to more frequent and more damaging storms (De Lillis et al. 2004).

Central Coast Wetlands Group at Moss Landing Marine Labs and Coastal Conservation and Research have worked since 2016 in partnership with State Parks to restore sensitive dune habitat at SRSB and monitor restoration efforts. Restoration efforts include eradication of invasive ice plant and reestablishment of native plants through planting, seeding, and natural recruitment. Ice plant is eradicated through spraying of herbicides and hand pulling. Sprayed ice plant is left in place to act as mulch for native plants. Seeds from native plants collected from the SRSB dunes complex are propagated and planted during the rainy season. Efforts to increase the structural integrity of the dunes includes strategic use of driftwood and hay bales to help accrete sand to build dunes where iceplant has prevented the establishment of native vegetation that would otherwise serve this purpose.

Previous restoration related monitoring was conducted under a 2015 MOU which expired Dec 2020. The monitoring program outlined here is currently approved under a DPR Scientific Research and Collections Permit (Permit 720-4821-005, approved April 19, 2021, expires March 31, 2022). The project team will renew the permit each year during the project for ongoing monitoring. Continued monitoring of native and non-native vegetation cover, special status species (legless lizard, gilia, *Chorizanthe*), and dune topography in relation to restoration areas and control sites (located adjacent to SRSB) will help answer questions related to restoration success, restoration methodology, and coastal resilience. All work will be coordinated closely with local State Parks staff and Point Blue snowy plover monitors.

Study Area

The project team members will conduct surveys at Salinas River State Beach (Figure 1) within the restoration project area (Figure 2).

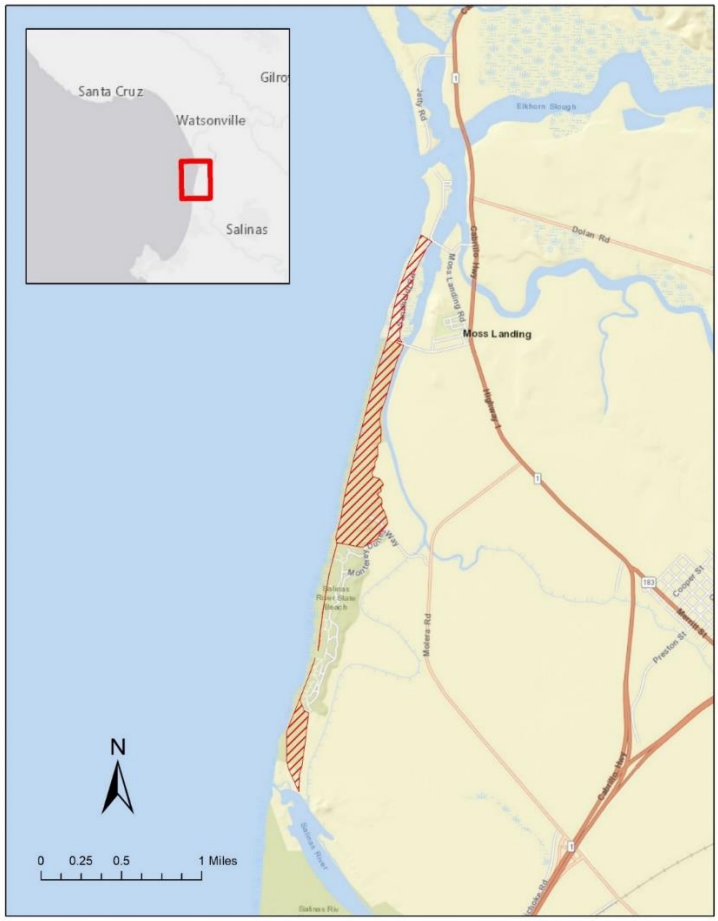

Figure 18. Salinas River State Beach vicinity map

Figure 19. Salinas River State Beach current and proposed restoration area where research activities may take place.

METHODS

1. Legless Lizard Surveys

This study plan was designed to characterize the distribution of Northern legless lizards (*Anniela pulchra*) and presence of the black legless lizard subspecies (*Anniela pulchra nigra*) within a portion of the Salinas River State Beach dune restoration project (Figure 3). The goal is to evaluate legless lizard habitat use in response to restoration of native coastal dune plant communities.

The dune restoration has occurred in phases with the oldest active restoration initiated previous to the year 2000. Subsequent restoration activities were initiated within a portion of the dunes in 2016, and two additional areas are planned for restoration (Figure 3). Restoration of these areas is an ongoing process with the intensity of activity occurring during the initial phases followed by regular but less frequent maintenance activities. In addition to the restoration areas, there is a small privately owned area of the dunes where no restoration has yet occurred, and for the time being this area will be used a control in the evaluation of habitat recolonization associated with improved conditions.

Surveys for legless lizards will involve the use of coverboards (Hunt and Zander 1997), time constrained searches (Bury and Rachael 1983), and fixed-area plot sampling (Szaro et al. 1988). Although detection of legless lizards using these methods may not strongly correlate with population densities, these methods have been demonstrated to be effective at detecting presence of legless lizards in a coastal dune setting (Kuhnz et al. 2005). These methods also can be deployed in an area dominated by sensitive vegetation communities, such as are found in coastal dunes, without impacting vegetation. Coverboards will be distributed to optimize the probability of detecting legless lizards by placing them near native vegetation and utilizing microhabitat characteristics (Kuhnz et al. 2005).

Coverboards will be unpainted plywood cut into approximately 60 cm x 60 cm (24 in x 24 in) squares, each of which is numbered, and the location recorded with a handheld GPS unit. Coverboards will be placed within each of the restoration phase areas of the dunes at a density of 5 coverboards/hectare. Coverboards will be placed in areas that are out of sight to beach visitors and will be placed behind the foremost dune ridgeline so that monitoring activities will be out of sight of snowy plover nesting habitat. Care will be taken to avoid impact to vegetation during placing and checking of coverboards.

Figure 20. Legless lizard study area showing the restoration phases and proposed locations of cover boards.

In addition, we will conduct seasonal surveys for legless lizards utilizing a variety of focused search methods. Given the purpose of this monitoring effort is to evaluate habitat use by legless lizards in relation to community level plant restoration of the dunes. We would expect that areas supporting a diverse native plant community would support higher density populations of legless lizards, given the species has been found to avoid areas dominated by ice plant (*Carpobrotus edulis*) or exotic grasses (Kuhnz et al. 2005). We also expect that legless lizards would be more likely to have successfully re-colonized areas where the native plant community has recovered for longer periods of time, such as the Moss Landing Marine Laboratory restoration (Area A), which was initiated before 2000. We would also expect legless lizard population density to be lower in areas dominated by ice plant (Area D), and we would expect that we may expect a gradient of population densities that reflect the relative degree of recovery of the native plant community in the other areas.

Searching based surveys aimed at maximizing detection rates will be done when conditions are optimal for detecting the target species. We will conduct fixed-area plot sampling surveys during the late winter and spring/early summer months when warmer weather results in increased legless lizard activity. We may also employ a time-constrained search method opportunistically, such as when the CCWG restoration crew is present on the site. All surveys will be conducted behind the dune crest and in coordination with State Parks and Point Blue.

Coverboards will be surveyed on a monthly basis during warm periods between 1 April and late summer. Fixed-area plot sampling and time-constrained searches will be conducted during the spring and summer months when conditions are optimal with additional time-constrained searches conducted opportunistically. Coverboard surveys and searched based surveys will be specific to the different phases of restoration.

Access to the study site will be through established beach trails (Sandholdt Rd and Potrero Rd beach access trails) and routes of travel to cover board locations will be along the back dune to avoid any disturbance to snowy plovers breeding habitat.

2. Native/Non-native Vegetation Transect Surveys

Plant surveys will be conducted during active restoration efforts and immediately post restoration. Long-term post restoration monitoring will continue if funding allows. Vegetation surveys will document successful reestablishment of native plant species, successful eradication of invasive plants, identify areas where greater species diversity is needed, and locations of sensitive species. Presence of ice plant during monitoring will be noted and reported to maintenance crew for spraying or hand removal. Vegetation monitoring will occur once before restoration initiation, twice a year during grant implementation years, and once post implementation. Vegetation monitoring will consist of approaches such as:

a. **Transects perpendicular to the coastline (point-intercept percent cover)**
   Perpendicular transects will be established every 100-200 meters (depending on restoration area size) within active restoration areas. Each transect will be scaled to the system, generally 75-100m in length (approximate distance from foredune to backdune). Each transect will be laid

perpendicular to shore and plant species will be recorded every one meter (Figure 4). Spatial information will be recorded. The zero mark will be on the seaward side of the dune and will increase moving inland. The transition from foredune to mid-dune will be recorded for each transect. In this way each transect can be separated into foredune and mid/upper dune, and the overall cover of plant species, bare sand and litter can be estimated for these zones. Surveys will also be conducted at an unrestored control site located directly adjacent to SRSB.

b. **Transects parallel to the coastline (point-intercept and quadrats estimating percent cover & species richness)**

Transects will be laid parallel to the coast within active restoration areas. Transects will be 50m in length. These transects will be placed at the foredune five meters inland from the start of vegetation growth, or further inland to sample the mid-dune or back-dune. The parallel transects will be sampled with the point-intercept method to quantify overall percent cover (Figure 4). Five randomly placed quadrat ($1m^2$) may also be sampled within every 50-meter segment along transects to estimate percent cover within each quadrat. Further, rare species along the entire transect will be noted. These transects will quantify the diversity on the site to capture the presence of rare species. Quadrat sampling is optional for documenting species diversity while the point-intercept sampling is the minimum standard for percent cover data collection. Surveys will also be conducted at an unrestored control site located directly adjacent to SRSB.

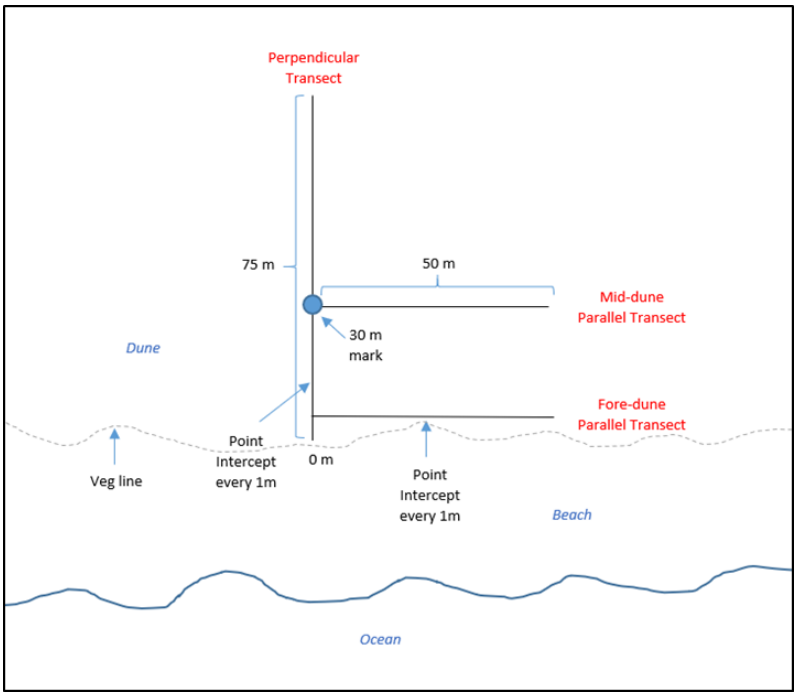

Figure 21. Example vegetation monitoring methodology (strategy a and b outlined above) map

c. **Drone Imagery**
High resolution orthoimagery collected as part of dune topographic mapping effort (see Dune Topography Surveys section) may be used in conjunction with on the ground vegetation surveys to evaluate percent cover of native and non-native vegetation and bare sand over time, as well as used to help inform restoration activities, such as identifying persistent patches of ice plant.

3. Rare plant surveys

Surveys for sensitive plant species such as sand gilia (*Gilia tenuiflora* ssp. *Arenaria)* and Monterey spineflower (*Chorizanthe pungens v. pungens* will occur annually before active restoration activities (e.g. herbicide application) begin. Sensitive plant survey may include one of two methods depending on funding availability:

a. **Opportunistic surveys**: observations of sensitive plant occurrences while conducting standard vegetation point intercept surveys (see above). Sensitive species will be flagged and GPS locations recorded to help inform locations to avoid during herbicide application.

b. **Annual Spring surveys to document distribution and abundance:** The team will survey for sand gilia (*Gilia tenuiflora* ssp. *Arenaria)* and Monterey spineflower (*Chorizanthe pungens v. pungens)* using a protocol for rapid detection, approximation of patch size, and order-of-magnitude estimation of abundance. Surveys for target species will be timed to coincide with peak bloom periods (March-June) of target plant species allowing accurate identification to a species level. Using ArcPro's fishnet grid tool, transects will be stablished over the survey site. The surveyor will walk back and forth along transects in a mowing-the-lawn-pattern, with about 5m between adjacent passes (unless terrain makes this impossible). Each search transect will be followed in the field using a handheld GPS unit until a target plant occurrence was encountered. GPS Tracks will be recorded for the purpose of documenting survey effort. A waypoint will be made for every group of 1-10 plants, using a GPS with ~3m accuracy.

   Field data will be downloaded and post-processed in the office. Using a GIS application, polygons will be manually drawn around the clusters of waypoints. Abundance will be estimated within polygons depending on the species. GIS data will be exported as shapefiles and will be used to prepare maps depicting plant species distribution. This survey method can be done quickly and is less invasive than other more intense methods, while still obtaining sufficient information for synoptic taxon-wide conservation assessment work (as opposed to a detailed monitoring or mapping of a single site). These surveys will take place take into account the following snowy plover avoidance-related measures:

   - Consult with Point Blue to receive general guidance on how far away from the coast to stay - e.g. stay essentially on the east-facing side, where you can't see the beach or the surf; and if you can see the wrack line, you're way too close.
   - Review Point Blue reports/nest maps sites to understand the typical distribution of nests in relation to the dune areas targeted for plant survey.

- Stay in contact with local State Parks staff during survey season and share rare plant survey maps, so that they have the opportunity to voice any concerns that might arise.

All observed occurrences will be submitted to CNDDB.

4. Dune Topography Surveys

3D Unmanned Aerial Vehicle (UAV) surveys over an area of ~0.12 km2, about 0.18 km wide and 1.2 km long, extending from the Moss Landing Marine Laboratories (MLML) Shore Lab (north side of restoration area) to the parking lot at Potrero Road to the south will be conducted twice annually in February and October, outside of the snowy plover breeding season. LiDAR data may also be collected to document beach and dune profiles. Surveys will document topographic profiles and dune elevation changes.

The UAV surveys use 24 already established ground control points (GCPs) that are homogenously distributed across the survey area (established in 2019). The GCPs were created by driving a 3 feet-long rebar in the ground and letting the top stick out from the ground a few cm and then are capped for safety. The tip of the rebar is too small to be able to be seen on the aerial photographs and a relatively large surface is required for the parallax correction. Before the UAV flight, the top of the rods are covered with 30 x 30 cm brightly colored bucket lids that are clearly visible and identifiable on the aerial photos and that can be matched with the software cap each GCP. The GCPs are surveyed using a high-accuracy (<2cm) differential GPS (Spectra SP20) in June 2020.

A 3D digital model (DEM) of the survey area will be created using the digital photos collected by the UAV need. These photos are processed using advanced photogrammetric software (we use Pix4D). The software automatically matches common points between photographs to create a photomosaic. To produce a DEM of the terrain, the software requires known points on the ground (GCPs) with X,Y, and Z coordinates.

Terrestrial Laser Scanner (TLS)-based, beach/dune morphology baselines to measure beach/volume change may also be produced using a Trimble VX Spatial Station. This state-of-the-art spatial station is equipped with Direct Reflex (DR) technology, a direct drive system with robotic servo-mechanisms and a built-in digital camera. The instrument is operated via radio-link by a controller unit, it can acquire accurate (<3 mm), multiple (15 points/s) spatial data (point clouds), and the range of operation of the DR laser is 2- to 500 m while on target mode (optical prism mounted on a survey rod) the acquisition can work as far as 2 km.

The TLS surveys would occur along transects (spaced about every 500m). The survey areas will cover a coast-parallel band of approximately 200m centered at the survey benchmark. For each survey area, 2 stable benchmarks (physically a ~5 foot long rebar hammered in the ground) will be determined using a differential GPS (horizontal and vertical accuracy ~2cm). The point cloud produced will include a cross-shore transect from the dune crest(s) to the beach. Scanning resolutions will range between 10 and 50cm with approximately 10,000 points collected per survey (Datums WGS84, NADV88). DR-technology and single point measurements with a survey rod will be combined to account for geomorphological features (e.g. slope of the foredune) not directly visible from the TLS or for areas covered by dense vegetation.

Post-processing of the TLS data will be done with Real Works (software by Trimble). Post-processing operations include editing of the point clouds, merging of point clouds and survey points collected from different fore-sights, interpolation and contouring, creation of surface meshes, and photographic rendering of three-dimensional (3D) surface models. Real Works will also be used for the analysis/parameterization of the surface scans (e.g. volumes, slope angles), to compare TLS and UAV data and for the serial scans to identify and quantify areas subjected to volume changes. The vertical datums of the beach and dunes will be defined relative to the operational MHW elevation datum for the Monterey Bay area (MHW for the closest tidal station Monterey Harbor is 1.40m NADV88).

Surveys may be conducted twice a year to capture seasonal dune changes. Surveys will occur outside of the plover season. Fall data collection will occur after September 30th and Spring data collection will occur before March 1st.

Sample Collections

Vegetation: single vegetation samples taken of unknown species from surveys for ID at lab

Initial Approved Schedule (2021-2022)

Field work: 5/1/2021 (or upon DPR approval) - 12/31/2022 (Table 2)

Table 8. Monitoring Schedule (approved for 2021-2022)

Monitoring Task	Month/Year																				
	2021									2022											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Legless Lizards																					
Native/Non-Native Veg Surveys																					
Gilia																					
Corinzanthe																					
Dune Topogrpahy Survyes																					

Products

- Database of collected monitoring data at SRSB provided to State Parks
- GIS layers of special status species locations provided to State Parks
- High resolution aerial imagery and DEMS of SRSB provided to State Parks
- Final Restoration and Monitoring Report provided directly to State Parks and made available on CCWG website

Anticipated Benefits to the State Park System

Monitoring efforts will provide Monterey State Parks District staff with more detailed information about SRSB flora and fauna distribution and abundance and success of restoration efforts. These monitoring efforts will also help the Natural Resource Division in its development of dune management for California State Parks. This project can lay the groundwork for a coordinated dune monitoring effort for State Parks that contain dune habitat.

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