The Greater 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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# CONTENTS

Existing Conditions and Background .................................................. 1

Introduction ......................................................................................... 1

Site Description ................................................................................... 1

Plants and Animals at the Dunes ......................................................... 5

Dunes and Iceplant ............................................................................. 10

Previous Restoration Efforts in Monterey Bay .................................... 12

Dunes as Coastal Protection from Storms ........................................... 14

Restoration Plan .................................................................................. 16

Summary .............................................................................................. 16

Restoration Goals and Objectives ....................................................... 18

Goal 1. Eradicate Iceplant from Fore and Mid Dunes ....................... 18

Goal 2. Establish Diverse Native Plant Composition in the Greater SRSB Dune Complex ................. 20

Goal 3. Enhance Storm Resilience of Dune System ............................ 23

Goal 4. Support Dune Management Efforts of California Department of Parks and Recreation ........ 26

Monitoring Program ........................................................................... 30

Summary .............................................................................................. 30

Plant Surveys ....................................................................................... 30

Topographic Surveys .......................................................................... 33

References ........................................................................................... 37

Appendix A: Project Requirements & Mitigation Measures ............... 39

Project Requirements .......................................................................... 40

Mitigation Measures ............................................................................. 47

Appendix B: Detailed Description of On-site Activities ....................... 49
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) and adjacent privately owned parcels 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. This plan will also document work that can be completed on the Moss Landing “Island” between the Sandholdt Bridge and the harbor mouth in partnership with private landowners including Moss Landing Marine Labs, Monterey Bay Aquarium Research Institute and the Moss Landing Harbor District. Specific partnership agreements will be drafted that outlines the specific project scopes for work that will be completed on the Island. The inclusion of these private partners will help to ensure the integrity of the sand dune complex remains intact and all parties are working to ensure the dune system continues to provide important habitat and coastal wave protection services.

SITE DESCRIPTION

The restoration site is located in North Monterey County, CA (Figure 1). Much of the 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.
Figure 1. Site vicinity map
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).

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.

Extending from the northern edge of SRSB at Sandholdt Road to the Moss Landing Harbor mouth are several parcels owned by Moss Landing Marine Laboratories, the Monterey Bay Aquarium Research Institute, the Moss Landing Harbor District, and Monterey County. Additionally, just south of the Sandholdt Road access, is a privately owned 2-acre parcel sandwiched between SRSB 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. With proper approval from landowners, locations within the parcels that contain dune habitat will be included in foredune enhancement, native dune habitat restoration, and access control efforts (Figure 2).
Figure 2. Privately owned parcels adjacent to SRSB for potential dune restoration projects
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. Open areas or low vegetation in dune areas can support ground-nesting species such as California quail. SRSB supports populations of federally and state listed and special status animal species (8), plant species (4) and plant communities (2) and several species endemic to California.

Plants

There are three plant communities at SRSB: foredune, coastal scrub and dune pond. The most common plant species of 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. The most common species 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 channel. The pond is seasonal and is surrounded by a sparse cover of sedges, rushes and grasses.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Common Name</th>
<th>Scientific Name</th>
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</thead>
<tbody>
<tr>
<td>Plant Species</td>
<td>Menzies’ wallflower</td>
<td><em>Erysimum menziesii</em> ssp. <em>menziesii</em></td>
</tr>
<tr>
<td></td>
<td>Monterey gilia</td>
<td><em>Gilia tenuiflora</em> ssp. <em>arenaria</em></td>
</tr>
<tr>
<td></td>
<td>Monterey spineflower</td>
<td><em>Chorizanthe pungens</em> var. <em>pungens</em></td>
</tr>
<tr>
<td></td>
<td>Sand-loving wallflower</td>
<td><em>Erysimum ammophilum</em></td>
</tr>
<tr>
<td>Plant Communities</td>
<td>Central dune scrub</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Northern coastal salt marsh</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Figure 3. Distribution of special status plant species within SRSB and adjacent dune areas.
Although there is a wide diversity of native species present in the SRSB, a 2015 analysis of aerial imagery revealed that iceplant cover of the vegetated foredune ranges from about 35 to 70 percent. Non-native invasive iceplant 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 iceplant to out-compete many native species and dominate resources, including space. In areas where iceplant 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.

Several special status animals occur within SRSB and the adjacent dune areas including globose dune beetle (*Coelus globosus*), California legless lizard (*Anniella pulchra*), tidewater goby (*Eucyclogobius newberryi*), longfin smelt (*Spirinchus thaleichthys*), bank swallow (*Riparia riparia*), western snowy plover (*Charadrius nivosus nivosus*), and short-eared owl (*Asio flammeus*) (Table 2, Figure 4, Figure 5).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank swallow</td>
<td><em>Riparia riparia</em></td>
</tr>
<tr>
<td>Black legless lizard</td>
<td><em>Anniella pulchra nigra</em></td>
</tr>
<tr>
<td>Globose dune beetle</td>
<td><em>Coelus globosus</em></td>
</tr>
<tr>
<td>Longfin smelt</td>
<td><em>Spirinchus thaleichthys</em></td>
</tr>
<tr>
<td>Salinas harvest mouse</td>
<td><em>Reithrodontomys megalotis distichlis</em></td>
</tr>
<tr>
<td>Short-eared owl</td>
<td><em>Asio flammeus</em></td>
</tr>
<tr>
<td>Tidewater goby</td>
<td><em>Eucyclogobius newberryi</em></td>
</tr>
<tr>
<td>Western snowy plover</td>
<td><em>Charadrius nivosus nivosus</em></td>
</tr>
</tbody>
</table>
Figure 4. Distribution of special status mammal and bird species within SRSB and adjacent dune areas.
Figure 5. Distribution of special status reptile, fish and insect species within SRSB and adjacent dune areas.
**Dunes and Iceplant**

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](image)
Invasive Iceplant 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, iceplant 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 iceplant (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. Iceplant 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 iceplant that exhibit periodic disturbance and open sand areas. The removal of dense iceplant will allow for greater open area for the recruitment of native species including spineflower and gilia.

Iceplant Cover and Distribution

Iceplant has recruited and now dominates much of the SRSB dune complex. Initial aerial estimates of iceplant percent cover within the foredune of SRSB is shown in Table 3. The remainder of the dune plant community is comprised of a mix of native species including those within Table 4 (page 20).

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

<table>
<thead>
<tr>
<th>Dune Restoration Section</th>
<th>% Iceplant of Total Veg Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandholdt Rd access to Potrero Rd access</td>
<td>50-70%</td>
</tr>
<tr>
<td>Potrero Rd access to Molera Rd access</td>
<td>35-65%</td>
</tr>
<tr>
<td>Molera Rd access to Monterey Dunes Colony</td>
<td>50-60%</td>
</tr>
<tr>
<td>Salinas River</td>
<td>35-60%</td>
</tr>
</tbody>
</table>
**Previous Restoration Efforts in Monterey Bay**

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 I 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. Iceplant was eradicated from 20 acres of priority dune habitat within SRSB, through spraying of herbicides and hand pulling. Sprayed iceplant 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.

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 iceplant, 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 iceplant. Studies suggest that the removal of iceplant 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 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 limit 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 iceplant 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.

The Moss Landing “Island” is the term given to the northern half mile of the dune complex directly south of the harbor mouth. This section of the dunes has been used by industry for more than a century. Development on the dunes was designed to be resilient to 20th century coastal processes and ocean elevations. Today, coastal squeeze, beach erosion and uncoordinated management of the dunes has led to a complex that is vulnerable to winter storms and predicted sea level rise. By 2030 (or 0.3 ft of SLR), wave overtopping of this portion of the dunes may occur and could lead to significant impacts within the harbor.
To maintain a resilient and continuous dune complex between the River and the Harbor, property owners have met and discussed working together to manage the dunes as a complex.

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 iceplant (Carpobrotus edulis and Carpobrotus chilensis) and other invasive plants. Iceplant 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.
RESTORATION PLAN

SUMMARY

CCWG and CCR will work in partnership with DPR and adjacent land owners to restore (eradicate invasive iceplant and reestablish native plants) as much of the sensitive dune habitat at SRSB, and adjacent parcels containing dune habitat, between the Moss Landing Harbor and Salinas River mouth as funding will allow (Figure 8). This restoration plan will guide ongoing efforts to remove all iceplant from the dune system, increase native plant density and increase foredune resiliency to wave impacts. We anticipate ongoing partnerships with state agencies and local NGOs and land owners to implement this plan through a number of incremental restoration activities (i.e. completed Phase I restoration effort 2016-2019).

Moving forward, iceplant will be eradicated primarily through the use of hand spraying herbicide (typically using a 2% dilution of glyphosate). Hand pulling of iceplant will be used around native plants and in areas where special status plant species are present. Sprayed iceplant will be left in place to act as mulch for native plants. Iceplant will be left to decompose for approximately 4–9 months before native plants are planted within it. 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. Additionally, seeds will be hand broadcast and lightly raked into dune areas with bare sand. Efforts to increase the structural integrity of the dunes will include strategic planting placement and the use of drift wood, hay bales, or jute fencing to help build 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.
Figure 8. Restoration areas targeted for invasive species removal and reestablishment of native dune vegetation. Trail and access locations are potential areas for fencing and signage.
**Restoration Goals and Objectives**

Goal 1: Eradicate iceplant from the greater SRSB dune complex.
   Numeric objective: maintain iceplant to less than 5% total cover, similar to reference sections of the dunes restored in Phase I.

Goal 2: Establish diverse native plant species composition in treated dune areas
   Numeric objective: establish dunes with species composition similar to reference sections of the dunes restored in Phase I (more than 30% total cover).

Goal 3: Enhance storm resilience of dune system and report results
   Numeric objective: document sand accumulation within vulnerable areas of the dunes at rates that exceed background rates.

Goal 4: Support DPR and adjacent land owners in efforts to enhance long-term management of Monterey dune ecosystems

**Goal 1. Eradicate Iceplant from Fore and Mid Dunes**

**Iceplant Eradication**

A field crew of 2–4 members will be responsible for spraying iceplant within the restoration area (Figure 8) with a focus on the fore and mid dune area. Spraying will occur approximately 4–9 months prior to revegetation efforts to allow enough time for the iceplant to decompose and allow for easier planting. Areas with thick iceplant may need to wait until after a second year of spraying before planting. In areas with a substantial cover of native species, iceplant should be sprayed in late fall when the natives are essentially dormant and germinating native seedlings are limited. In weedy, disturbed areas, iceplant 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 iceplant and native dune species (including *Dudleya*) and will have proper certifications to use the spray application equipment. A 2% dilution of glyphosate (+ surfactant solution) with added tracer die will be used. Iceplant 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 calm and dry days to prevent chemical drift from wind and rain. A second spot application will be completed approximately 3–9 months after the initial application to address areas where iceplant remains robust. 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. Sprayed iceplant will be left in place to act as mulch for new native plants.

In many places, native species are intermixed with the iceplant and therefore care will be taken to minimize drift or overspray of herbicides on native plants. No spraying will occur in areas where sand gilia and Monterey spineflower are present. Iceplant in those areas will be hand pulled to protect the special status...
plants. After planting and seeding occur, herbicide spraying will be limited to areas where overspray will not jeopardize native plants.

Small patches of iceplant may be hand pulled whenever staff familiar with the eradication procedures is on site. Iceplant will be disposed of offsite in approved composting areas.

**Additional Invasive Species Control (as funding permits)**

1. **Iceplant outside of the project focus area:** Successful eradication and/or control of iceplant populations require management of recruitment of new plants from adjacent areas. Iceplant fragmentation and seed dispersal from adjacent dunes can lead to re-establishment of populations within the restored areas. Annual spot check surveys and removal of recruits is necessary. Fragmentation and encroachment by existing iceplant populations within adjacent areas of the dunes represents a significant challenge to maintenance of restored areas. As funding allows, the restoration team will work with DPR and adjacent land owners to spray and manually remove iceplant inland of the restoration focus area to ensure that recruitment pressure to the foredune after restoration is managed. Project staff will identify priority areas within the back dune community where iceplant can be eliminated, establishing isolation areas to protect the restoration program and support long term elimination of iceplant from the dune system between the Salinas River and the harbor mouth, to provide maximum adaptive capacity to SLR.

2. **Spraying of European beach grass (**Ammophila arenaria**):** Ammophila sp. is present on the adjacent Monterey Dunes Colony property and has recruited to one area south of the Colony and one area near the Moss Landing Marine Labs Shore Lab. 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.

3. **Arundo donax management:** *Arundo donax* is present near the southern end of the focus area and efforts will be made to eliminate the species from the north River mouth area. The *Arundo* will be 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 working.

**Long-term Weed Eradication and Control**

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 iceplant recolonizes. Recolonized areas will be noted using a GPS unit and reported to the Project Manager and DPR staff. As resources are available, qualified field crews will revisit areas where iceplant, *Arundo donax*, or European beach grass reestablishes and spray or pull the plant as needed. Work will be scheduled to avoid impacts to western snowy plovers.
GOAL 2. ESTABLISH DIVERSE NATIVE PLANT COMPOSITION IN THE GREATER SRSB DUNE COMPLEX

Species Composition of Dune Complex

The most dominant native plant species of the SRSB dunes include those listed in Table 4 and will be planted or seeded in densities sufficient to achieve a percent of plant cover similar to reference areas established during Phase I of the project.

Table 4. Native dune plants at SRSB and prescribed % of total plant cover for revegetation efforts.

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

100% 100%
Seed Collection
Trained botanists and restoration crew members will collect seeds of native species listed in Table 4 within the greater 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 and out planting during the fall/winter planting season.

Dune Grass Rhizome Collection
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
A seed mix of native species will be created (based on Table 4) and 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 spayed iceplant 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 iceplant litter and raked in lightly. Two seed mixes shall be created, corresponding to the species diversity of the fore or mid-to-rear dunes. An estimate of 10 pounds per acre of seed is needed where broadcast seeding will occur.

Dune Plant Propagation
Dune plant species from the DPR-approved list 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. 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 Techniques:**

1. **Iceplant mulch and native planting**

Desiccated iceplant material will be present throughout the dunes after the herbicide spraying (approximately 6 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 iceplant 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 iceplant removal areas (with and without the presence of iceplant 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. Plants will be watered after planting. 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. 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. Additional watering during the project period may occur if necessary.
GOAL 3. ENHANCE STORM RESILIENCE OF DUNE SYSTEM

Increasing Erosive Resistance of Dunes

Several studies have documented the increased vulnerabilities to wave impacts posed by iceplant 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 iceplant hardened foredunes 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 ice plant 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 Processes of Foredune Failure

Three key processes that lead to foredune failure will be ameliorated through removal of iceplant 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 iceplant 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).

**Key Actions to Reduce Erosion**

Key actions that will be taken to reduce these three coastal erosion processes include:

1. **Increase complexity of foredune**
   
   Native species will be planted within areas where ice plant was removed. Species including the native dune grass (*Leymus mollis*) and beach bur (*Ambrosia chamissonis*) will be planted directly in front of dunes with steep faces.

2. **Enhance structural integrity (using driftwood or straw bales) of foredune**
   
   Locally derived large driftwood or straw bales will be placed in areas along the foredune where dunes are steep and where previous wave erosion scars are evident. The wood or straw bales will be placed in low density to increase roughness and provide three-dimensional stability as native species reestablish*.

3. **Enhance contours to reduce erosive impacts of waves**
   
   There are several areas of SRSB where dune erosion is evident and may lead to further wave impacts and possible dune overtopping during extreme storm events.

   a. **Eliminate perpendicular access ways:** There are several coastal access ways from inland trails and parking lots that lead out to the beach perpendicular to the shore. These visitor derived dune scars provide optimal wave ramps and funnels to encourage wave run-up and potential dune overtopping. By realigning these access ways (through restoration and fencing of a portion of the broad beach entrance) to angle away from the dominant wave angle, these enhanced access ways will limit wave funneling.

   b. **Encourage dune aggradation and enhanced dune roughness in low relief foredune areas:** Several strategies will be used to aid sand accumulation in areas where sand migration and foredune topography have been compromised by ice plant.

      i. Native plantings of beach bur and dune grass will be placed forward of the dune faces to encourage low density reestablishment of native species and foredune topographic complexity*. 

ii. Straw bale planting mounds will be placed in low density in areas where erosion scars have cut into the foredune to eliminate wave run-up ramps*.  

iii. Decomposing drift fence (jute and bamboo) may be used in short segments (as not become a barrier to plover movement) to encourage sand deposition, reestablishing foredune complexity*.  

iv. 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.  

v. Locally derived driftwood may be placed sparsely along the dune front to increase foredune roughness and complexity*. Driftwood will not be used as an alternative to coastal hardening.  

c. Beach and dune nourishment: The Moss Landing Harbor District must routinely (approx. every 5 yrs) conduct harbor dredging operations to maintain necessary harbor depth to service large commercial and research vessels. Recent Coastal Commission actions have led to the placement of appropriate (sand) dredge materials on the beach along Moss Landing Island. Efforts to coordinate placement and dune enhancement through beach nourishment include:  

i. Establish working agreement with various landowners to work collaboratively on dune restoration, enhancement, erosion control and beach nourishment.  

ii. Identify specific needs of each partner and draft management plan for the Moss Landing Island.  

iii. Coordinate with DPR, the Harbor District, and Coastal Commission to integrate parcel-specific restoration goals and permit requirements with agency management and operational objectives.  

iv. Ensure Moss Landing Island projects conform with goals of this management plan and obtain consistency confirmation from agencies.  

*Note: All area-specific planting and the use and placement of drift wood or straw bales 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 CALIFORNIA DEPARTMENT OF PARKS AND RECREATION

Trail System Improvements
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 8 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.

Additional trail improvement work may include the removal of the dilapidated boardwalk at the Molera Road beach access (Figure 9). 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.

Similar maintenance and access management will occur on the Moss Landing Island to reduce impacts to dunes in this area in partnership with dune management partners.
Figure 9. Molera access boardwalk and redundant trail removal project site map. Similar main trail enhancement projects at other locations will be coordinated and implemented in partnership with CDPR as described within this Restoration Plan.
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 8 for access points and trail locations). During Phase I of the project, a 3-paneled kiosk was installed at the Molera Road beach access parking lot, two 2’ x 3’ 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 10 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 10. Sample kiosk and low-profile designs for interpretive signage

Ongoing Maintenance
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 iceplants (Carpobrotus edulis and Carpobrotus chilensis), slender iceplant
(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 and other dune management partners. 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, MBARI, 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.

**Dune Restoration Monitoring**

Periodic plant monitoring efforts will be completed to quantify native species abundance and diversity, track changes in dune topography and identify and address recolonization by iceplant. Surveys will be completed by trained researchers and scheduled in foredune areas and other breeding habitat outside of the snowy plover nesting season. Please see the Plant Surveys section of this document for more information.

**Species Specific Response to Restoration Activities**

Removal of invasive iceplant 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). Questions regarding species response to iceplant removal will be investigated through research partnerships with Moss Landing Marine Labs and Cal State Monterey Bay faculty and graduate students.

**Avoidance and Mitigation Measures**

All sensitive species and their habitats were evaluated for potential impacts by this project (CCWG 2015, 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 have been developed and will 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 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 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 and mitigation measures and project requirements please see Appendix A.
MONITORING PROGRAM

SUMMARY

Periodic plant and dune monitoring efforts will be completed to quantify native species abundance and diversity, track changes in dune topography and identify and address recolonization by iceplant. Surveys will be completed by trained researchers and scheduled in foredune areas outside of Snowy Plover nesting season.

PLANT SURVEYS

Methods

Plant surveys will be conducted during active restoration, and post restoration if funding allows. Vegetation surveys will document successful reestablishment of native plant species, successful eradication of invasive plants and identify areas where greater species diversity is needed. Presence of iceplant 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 implementation, and once post implementation. Vegetation monitoring may consist of approaches such as:

1. **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 50-75m in length (approximate distance from fore to mid-dune). Each transect will be laid perpendicular to shore and plant species will be recorded every one meter (Figure 11). 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.

2. **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 generally be 50m in length. These transects can 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 11). Five randomly placed quadrat (1m²) 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 while the point-intercept sampling is the minimum standard for data collection.

3. **Treatments in replicates.**

Experimental treatments may be set up to help investigate best practices for eradicating iceplant and establishing natives on dunes. During initial monitoring, five large contiguous areas of iceplant (over 30 square meters) will be flagged to become replicate study plots. Within each plot, several restoration treatments will be determined based on priority research questions. Each treatment will be replicated across each of the five study plots. Treatments may include clearing space around planting vs. planting directly into decomposed iceplant, placing structures such as haybales or driftwood logs, supplemental water vs. no supplemental water, and planting at different densities or diversities of plant species. The individual treatments will be implemented within 2m diameter circular plots, which will be delineated using a central point and a 2m string or tape. These points will be marked with flags and the GPS location recorded. Percent cover and survivorship of plantings will be recorded during each sampling event.

Figure 11. Example vegetation monitoring methodology (strategy 1 and 2 outlined above) map
Sampling Schedule
Sampling events will occur twice a year during the funded project periods. 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.

Initial Results
Future restoration efforts will seek to replicate cover and diversity obtained within the Phase I dune restoration project (CCWG 2019).

Specifically:

Percent Cover
The following graphs show average native plant cover, iceplant cover, and other non-native cover for of the average of all vegetation transects throughout the Phase I restoration project period (2016 to 2019). Percent cover includes open sand areas of the dune system, not only the vegetation. The perpendicular point-intercept transect surveys found that iceplant was reduced from 23% to 3% total cover. Native cover increased from 27% to 36% total cover, and was greatest at 47% in Spring 2018. The cover of other non-native species increased from 1.8% cover to 2.4% total cover (Figure 12).

![Project Summary Perpendicular Point-Intercept](image)

Figure 12. Average of percent cover vegetation transects for entire project area

Species Richness
Species richness was calculated for each of the three restoration areas and is shown in Figure 13. Species richness did not change between the beginning and the end of the project. Diversity decreased after the initial spraying and iceplant removal and then increased during the second and third years of the project. The Potrero area had the greatest species richness, followed by the Salinas River mouth area, and then the Molera area.
Figure 13. Species Richness within each Restoration Area (Potrero, Molera, Salinas River) over time.

TOPOGRAPHIC SURVEYS

Methods

Dune profile surveys will be conducted before and after project implementation using Unmanned Aerial Vehicle (UAV) and differential GPS equipment. LiDAR data will also be collected to document beach and dune profiles. Future surveys will document topographic profiles and dune elevation changes expected within naturally evolving dune complexes.

A beach/dune morphology baseline assessment of the study area will be created before project implementation. DEMs of the entire section of the beach and adjacent dunes between the mouth of the Salinas River and the Moss Landing Harbor entrance will be created based on the stereophotogrammetric analysis (~2cm resolution) of surveys conducted with an UAV.

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 will 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 intense 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).

**Sampling Schedule**

Sampling events will occur once a year during the funded project period and will coincide with vegetation
surveys. Post-implementation surveys will be conducted once a year dependent on additional funding.
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.

**Initial Results**

Examples of survey comparisons between the initial (2015) baseline survey and the UAV-TLS surveys
carried out in 2018 after restoration (see Figure 14, Figure 15, and Figure 16). The most obvious and
expected change between the surveys that span a 3 year period is that while the dune habitats are relatively
stable the upper beach changes dramatically as a result of both wave energy at the time of the survey and
local wave dynamics. Accretion evidence was identified within areas where accretion Phase I restoration
experiments were implemented (Figure 15) (CCWG 2019).
Figure 14. Digital elevation models (DEMS) and aerial photographs of the UAV surveys. The maps on the right show elevation change in meters calculated by subtracting the 2015 from the 2016 surveys for the northern (Potrero) sites. Blue circle identifies areas where Phase I accretion (haybales and wood debris) experiments were completed.
Figure 15. Installation of drift wood and hay bales along the foredune help capture sand and increase dune roughness. Left: Initial placement of hay bales and driftwood near the Potrero Rd beach access trail. Right: After a few months the hay bales slowly decompose while continuing to help capture sand and add to foredune roughness.

Figure 16. Cross sectional dune elevations during three surveys (2015-2018). Note blue circle area suggesting initial accretion of foredunes after restoration and foredune stabilization.
REFERENCES


California Department of Fish and Wildlife (CDFW). 2014. State and federally listed endangered, threatened, or rare plants of California. California Natural Diversity Database.


Central Coast Wetlands Group (CCWG). 2015 Salinas River State Beach Dune Restoration Initial Study.


APPENDIX A
PROJECT REQUIREMENTS & MITIGATION 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. A responsible agency is a public agency other than the lead agency that has responsibility for carrying out or approving a project and for complying with CEQA. A trustee agency is a state agency having jurisdiction by law over natural resources affected by a project that are held in trust for the people of the State of California. With this distinction comes the responsibility to ensure that actions that protect both cultural and natural resources are always taken on all projects. Therefore, DPR maintains a list of Project Requirements that are included in project design to reduce impacts to resources.

**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. 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 50 ft (15.2 m) 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 (15.2 m) 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. In locations where avoidance of special status plants is not possible, the following conditions will be imposed:

   i. Prior to construction plants will be carefully excavated and transplanted nearby in suitable habitat. All transplant work will be conducted under the direction of a DPR-approved biologist.

   ii. Transplanting will occur during the dormant season (i.e. late fall) when the plants are least disturbed and can be watered by natural precipitation.

   iii. This requirement does not apply to sand gilia, and a permit will be required for any take of the species.

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

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

i. 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 and longfin smelt

   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. The project manager or a DPR-approved biological monitor will be on site during all activities to ensure there are no impacts to legless lizards or other amphibians or reptiles.

c. 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.

d. 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 and bank swallows

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 and bank swallows.

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. (152 m) 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 100 ft (30.5 m) radius of the nest tree or 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 (300 m) 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 (200 m) 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 environmentally sensitive areas. 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 (25 m) 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 (15.2 m) 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.

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 North Central Coast Air 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.

**Mitigation Measures**

The following mitigation measures would be implemented as part of the Project.

**Biological Resources**

**Plants**

Plant surveys will be conducted 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.

**Short-eared owl and bank swallow**

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 or bank swallow breeding seasons, March 1 to September 30, a DPR-approved biologist will conduct surveys at project sites for nesting bird presence within 7 days prior to the start of onsite work under the following conditions:

- **Raptors**, including short-eared owls: if nesting raptors are found, no onsite activities shall occur within a 500 ft (152 m) radius of the nest tree or ground 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**, including bank swallows: if active nests are located, no onsite activities shall occur within a 100 ft (30.5 m) radius of the nest tree or 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.
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.
APPENDIX B
DETAILED DESCRIPTION OF ON-SITE ACTIVITIES
<table>
<thead>
<tr>
<th>RESTORATION: INVASIVE ERADICATION AND NATIVE PLANTING AND SEEDING</th>
<th>SCHEDULE</th>
</tr>
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<tbody>
<tr>
<td>Iceplant Eradication: Spraying/Hand pulling</td>
<td>Spring and Fall</td>
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</tbody>
</table>

**Description:** A restoration crew will eradicate invasive species on approximately at SRSB, focusing on iceplant (*Carpobrotus edulis and chilensis*). Eradication will include standard methods demonstrated effective on previous nearby projects. Methods for removing iceplant will focus on herbicide spraying (using prescribed restoration methods), and hand-pulling. Removal efforts will be restricted between March–September on foredunes to avoid Snowy Plover breeding season. The first year will focus on spraying of iceplant using 2% glyphosate/1.5% imazapyr mix + surfactant solution, the second year will focus on hand removal. Sprayed iceplant will be left in place to act as mulch. Natives will be planted within the dead iceplant. Spot checks will be done in subsequent years and any alive iceplant will be resprayed or removed by hand.

**Equipment:** backpack sprayer, gloves, herbicide (2% glyphosate/1.5% imazapyr mix + surfactant solution)

**Staging Area:** Molera Rd or Potrero Rd parking lots, and farm road by the mouth of the Salinas River

**Days/Hours:** Work will occur between the hours of 8am and 5pm. Spraying is estimated to take 2–3 weeks the first year. Minimal spraying will occur the second year in places with dense iceplant mats that will need a second application of herbicide. Hand pulling will occur during the second year. Hours for hand pulling on dependent on amount of iceplant that will need to be pulled.

**Number of people:** Max 5

**Additional info:** Spraying will be conducted using only handheld, targeted spraying as opposed to aerial spraying; the crew will avoid spraying during windy or rainy conditions; and sprayed areas will be blocking off for 24 hours. Majority of spraying will occur outside of the plover breeding season (after October). Any spraying that will occur during the plover season will be located outside of the snowy plover breeding habitat and will be conducted in consultation with DPR and Point Blue. Restoration crew will follow MSDSs for each chemical used. All herbicide of will be transported and disposed of in accordance with the specific MSDS.

<table>
<thead>
<tr>
<th>Outplanting</th>
<th>November-February</th>
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</table>

**Description:** Native plants will be established on the dune through out-planting (and seed dispersal, see task 2f). The planting density for propagated out-plants will be 1–3 plants/m² in iceplant removal areas. Lower planting densities are needed in areas with established but sparse native plants.

**Iceplant mulch and native planting**
Desiccated iceplant material will be present throughout the dunes after the herbicide spraying (approximately 6 months after initial application). This mulch material provides enhanced conditions for survival of planted juvenile native species. A four-inch spade will be used to cut through the iceplant mulch and juvenile native plants will be planted. Sand and mulch will be laid around the plant. Plants will be placed at distances of 6 to 18 inches apart, dependent on the expected width of a one-year-old plant.

**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.

**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. 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.

**Equipment:** shovels, trowels, plants, straw bales or other organic material such as locally derived driftwood

**Staging Area:** Molera Rd or Potrero Rd parking lots, and farm road by Salinas River Mouth

**Days/Hours:** Work will occur between the hours of 8am and 5pm. It is estimated that over the project period the restoration crew will spend approximately 4–5 weeks to install plants.

**Number of people:** Max 5

**Additional info:** Please see Education and Outreach section to see info about school and community planting days. All planting will occur outside of the plover season.

<table>
<thead>
<tr>
<th>Seed Collection for Seed Dispersal</th>
<th>Description: Trained botanists and restoration crew members will collect seeds of native species recommended by DPR at 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.</th>
<th>Spring, Summer, &amp; Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment:</strong> paper bags</td>
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<tr>
<td><strong>Staging Area:</strong> none needed</td>
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<td></td>
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<tr>
<td><strong>Days/Hours:</strong> Seeds will be collected between the hours of 8am and 5pm. It is estimated that over the project period it will take approximately 40 hours for the crew to collect the seeds.</td>
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<tr>
<td><strong>Number of people:</strong> Max 5</td>
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<td><strong>Additional info:</strong> Majority of seed collection will occur outside of the plover season. However, because some plants produce seeds during the Spring or Summer (during the plover season) the restoration crew will work with DPR and Point Blue to identify locations in the dunes where they can collect seed without disturbing breeding habitat.</td>
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<tr>
<th>Broadcast Seeding</th>
<th>Description: The restoration crew will hand broadcast local native seeds in areas where the sand is relatively stable and some native vegetation is present. Further broadcast seeding may be feasible where spayed iceplant 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</th>
<th>November–January</th>
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are not expected to negatively impact sand gilia or snowy plover breeding habitat per DPR and Point Blue guidance. Seed will be spread by hand onto the sand or fully decomposed iceplant litter and raked in lightly. Two seed mixes shall be created, corresponding to the species diversity of the fore or mid-to-rear dunes. An estimate of 10 pounds per acre of seed is needed where broadcast seeding will occur.

**Equipment:** seeds and rake

**Staging Area:** none needed

**Days/Hours:** Work will occur between the hours of 8am and 5pm. It is estimated that over the project period, hand broadcast seeding will take approximately 30 hours.

**Number of people:** Max 3

**Additional info:** Seed dispersal will be conducted outside of the plover season.

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**TRAIL & ACCESS ENHANCEMENT**

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<tr>
<th>Signs</th>
<th>Description: Interpretive signage will be installed at SRSB at coastal access points and along main access trails to provide information about sea level rise, dune erosion, habitat restoration, and endangered species. All 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. Signs to be installed: two smaller (2x3 foot) interpretive/educational signs at Sandholdt Rd parking lot and additional dune interpretive/regulatory signs along back dune.</th>
<th>Schedule: As needed</th>
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<tr>
<td><strong>Equipment:</strong></td>
<td>Work will occur between the hours of 8am and 5pm. Sign and posts, post hole diggers, two-man power auger, concrete mix, wheelbarrow, shovels, small hand tools.</td>
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<td><strong>Staging Area:</strong></td>
<td>Molera Rd, Potrero Rd, Sandholdt Road</td>
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<td><strong>Days/Hours:</strong></td>
<td>It is estimated that it will take no more than 2 days (16 hours) to install signs.</td>
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<td><strong>Number of people:</strong></td>
<td>Max 3</td>
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<tr>
<td><strong>Additional info:</strong></td>
<td>Regulatory/signs that will be installed on the back dune trail between Molera Rd and Potrero Rd access points may be bolted to existing fence posts. No signs will be placed on the beach.</td>
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| Trail fencing             | Description: SRSB has approximately 7,000 feet of existing trails. With direction from DPR, the project will install or upgrade post and cable or no-climb (or similar) 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. Trail fencing is currently prioritized at Molera Rd access trail and along the private parcel of the back dune trail between the Potrero Rd and Sandholdt Rd parking lot. | Schedule: As needed |
|                           | **Equipment needed:** Fencing, post hole diggers, two-man power auger (needed for areas with hard ground, but not for soft sand), chainsaw |

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fencing stretcher, top wire puller (clamp), come along, digging bar, hand level, hammers, fencing pliers hog ring wrenches, string line, pin flags (for layout), wheel barrows.

**Staging Area:** Molera Rd, Potrero Rd, and Sandholdt Rd parking lots.

**Days/Hours:** Fence installation will occur between 8 am and 5pm. It is estimated that fence installation will take up to ten, 8-hour days (80 hours total).

**Number of people:** 3–10 depending on organization installing fencing.

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<tr>
<th>MONITORING</th>
<th>SCHEDULE</th>
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| **Vegetation Monitoring**          | **Description:** CCWG will conduct plant surveys throughout the project period. Vegetation surveys will document successful reestablishment of native plant species, successful eradication of invasive plants and identify areas where greater species diversity is needed. Additional surveys will occur at Moss Landing State Beach where a restoration project is already in place to help compare restoration success. Presence of iceplant during monitoring will be noted and reported to maintenance crew for spraying or hand removal. Vegetation monitoring will occur once before implementation, twice a year during implementation, and once post implementation. Vegetation Transects will be set up in conjunction with dune morphology surveys.  
  **Equipment needed:** Pin flags, quadrat, GPS  
  **Staging Area:** none needed  
  **Days/Hours:** Surveys will be conducted between the hours of 8 am and 5pm. It is estimated that each survey will take approximately three, 8-hour days. Total days throughout project period is estimated to be 10 days (total 240 hours).  
  **Number of people:** 1–2 people  
  **Additional Info:** Surveys will be conducted outside of the plover season. | February and October |
| **Dune Morphology Monitoring**     | **Description:** CCWG will conduct dune profile surveys before and after project implementation using a Terrestrial Laser Scanner (TLS), and differential GPS equipment. LiDAR data will also be used to document beach and dune profiles. Future surveys will document topographic profiles and dune elevation changes expected within naturally evolving dune complexes. Transects will be set up in conjunction with vegetation surveys. The TLS surveys will occur along 8 transects (spaced about every 500m). The survey areas will cover a coast-parallel band of approximately 200m centered at the survey benchmark. 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. 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 intense vegetation.  
  **Equipment needed:** Terrestrial Laser Scanner, differential GPS, pin flags | February and October |
**Staging Area:** none needed

**Days/Hours:** Surveys will be conducted between the hours of 8 am and 5pm. It is estimated that each survey will take approximately 3 days (24 hours). 3–4 surveys are expected to occur over the project period.

**Number of people:** 1–2 people

**Additional Info:** Surveys will be conducted outside of the plover season.

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<tr>
<th>OUTREACH AND EDUCATION</th>
<th>SCHEDULE</th>
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<tr>
<td><strong>School or Community Planting or Seed Collection days</strong></td>
<td><strong>Winter &amp; Spring</strong></td>
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<td><strong>Description:</strong> CCWG will work with the North Monterey County Unified School District to coordinate and hold planting days for students at dune restoration sites.</td>
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<td><strong>Equipment needed:</strong> shovels, trowels, plants, shade tent</td>
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<td><strong>Staging Area:</strong> Molera Rd, Potrero Rd, or Sandholdt Rd parking lots</td>
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<tr>
<td><strong>Days/Hours:</strong> Each planting day will be approximately 4 hours long. There will be no more than 3 school planting days per year.</td>
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<td><strong>Number of people:</strong> Max 60 students, 10 staff</td>
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<td><strong>Additional info:</strong> Students and/or volunteers participating in planting or seed collection days will be given a lesson on the importance of dune habitat and how to walk through the dunes to minimize disturbance. Students and/or volunteers will be broken up into smaller groups and groups will be spread out. Students will work primarily in places without dense areas of native plants to minimize disturbance to existing native species. Students and/or volunteers will be supervised by restoration professionals. Planting days will take place outside of plover season.</td>
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