Restoration of the Northern Dune Additions to Humboldt Bay National Wildlife Refuge

Draft Environmental Assessment

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Estimated Lead Agency Total Costs Associated with Developing and Producing this Environmental Assessment - $10,000

U.S. Fish and Wildlife Service

Humboldt Bay National Wildlife Refuge

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Contents

Figures and Tables

Chapter 1. Introduction

1.1. Proposed Action

We, the U.S. Fish and Wildlife Service (Service), propose to restore 300 acres of coastal dunes located north of the Lanphere Dunes Unit of Humboldt Bay National Wildlife Refuge ("the Refuge"), through the removal of European beachgrass (*Ammophila arenaria*), yellow bush lupine (*Lupinus arboreus*), iceplant (*Carpobrotus edulis* x *C. chilense*), and invasive annual grasses followed by revegetation with native species. The California Environmental Quality Act (CEQA) checklist included as Attachment A has been completed for compliance with CEQA, should an agency of the State of California undertake the proposed action as its project.

1.2 Purpose and Need for Action

The restoration of coastal dunes is needed to conserve and restore globally rare dune and dune forest habitats, associated native plant and animal species, and to support recovery of threatened, endangered, and endemic species that depend on these rare habitats. Dunes in the vicinity of the project area are globally significant habitats, and have been undergoing restoration for three decades. The proposed project would extend dune restoration completed at the Lanphere and Ma-le'l Dunes Units into recently acquired and degraded parcels to the north. Ecological and geomorphic monitoring on the Lanphere and Ma-le'l Dune Units has demonstrated that removal of invasive plant species results in increased biodiversity as well as the restoration of underlying geomorphic processes. Research at the Lanphere and Ma-le'l Dunes Unit of the Refuge has shown that European beachgrass traps most of the sand blowing off of the beach on the lower, seaward slope of the foredune, rather than allowing sand to flow over the foredune and into the semi-stable dunes behind it. In contrast, native dune mat allowed sand to be transported up the face of the foredune and over the crest (Pickart 2014a). After removal of invasive species, sand is able to reach the foredune and backdune (Rader et al. 2018). This research as well as other studies (Christiansen and Davidson-Arnott 2004, Davidson-Arnott 2005) provide supporting evidence that inland flow of sand is a necessary condition for the foredune to migrate up in elevation as it moves inland in response to sea level rise, a process known as translation. These processes also increase the volume of sand in the foredune zone. Otherwise, as the erosion accompanying sea level rise occurs, the foredune may be at risk of eroding away instead of translating inland and upward, removing the buffering role the foredune plays in the dune system

1.3 Background

1.3.1 Location

The Proposed Action will be located within the Refuge boundary, just north of the Lanphere Dunes Unit. As shown in Figure 1, the sites proposed for restoration are the Bair, Hunt, Long, Demello, and Woll parcels. The Bair and Demello parcels were acquired in 2010 and 2011, and the acquisition of the Woll parcel is in process. The Service will not restore the Woll parcel until acquisition is final.

1.3.2 Previous Environmental Documentation and Planning Studies

The Proposed Action tiers from the 2009 Humboldt Bay NWR Complex Comprehensive Conservation Plan/Final Environmental Assessment (CCP/EA) (https://www.fws.gov/refuge/Humboldt_Bay/what_we_do/conservation.html) and from the 2015 Environmental Assessment on the Sea-Level Rise Adaptation Demonstration Project which are

incorporated by reference. The Proposed Action is consistent with Goal 2 of the CCP/EA which is to "Conserve and restore globally rare dune and dune forest habitats, and support recovery of threatened, endangered and endemic species." The Proposed Action is also consistent with Goal 3 of the CCP/EA which is to "Conserve and restore all refuge habitats through prevention and control of invasive plants and animals." The Proposed Action is consistent with the Recovery Plan for the Menzies' wallflower and beach layia (USFWS 1998) which calls for additional restoration of Ammophila-dominated dunes to native dune mat. The Proposed Action is also consistent with the Humboldt Bay Area Plan of the Humboldt County Local Coastal Program (LCP) (Humboldt County 2014). The Humboldt County LCP was effectively certified by the Coastal Commission in 1986 and has policies to protect Environmentally Sensitive Habitat Areas including dune habitats. The LCP was amended in 1993 to incorporate the Beach and Dunes Management Plan (Humboldt County 1993).

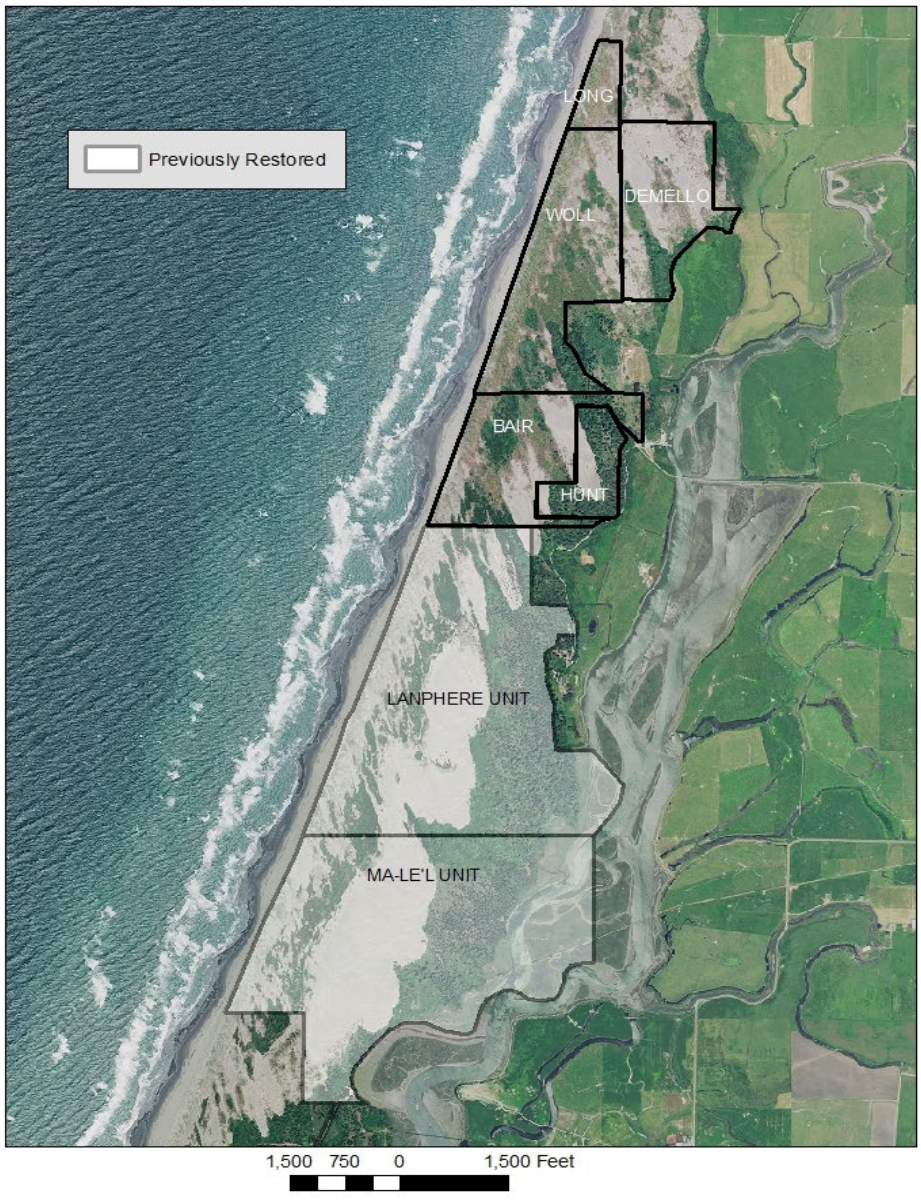

Figure 1. Location of parcels proposed for restoration

Chapter 2. Alternatives

2.1. Proposed Action

The proposed action consists of the following:

1) Restore 12.9 acres of foredune currently invaded by European beachgrass to a mix of dune mat and native dunegrass, using a combination of removal methods (prescribed burn, herbicides, manual removal) and replant with harvested divisions of dunegrass and beach bluegrass, and propagated plants of beach pea and beach morning glory;
2) Restore 72.6 acres of backdune area currently invaded by European beachgrass, yellow bush lupine, iceplant, annual grasses and pampas grass to dune mat using a combination of removal methods (manual removal, prescribed burn, flaming, herbicides, heavy equipment) and replant with propagated plants of a variety of dune mat species;
3) Restore 30 acres of backdune currently invaded by European beachgrass and yellow bush lupine to open sand using heavy equipment (soil inversion); and
4) Restore 21.4 acres of backdune currently invaded by yellow bush lupine to dune forest by planting with understory and overstory native species.

Restoration will draw on Integrated Pest Management (IPM) principles, using a variety of methods, including combinations of different methods. Methods by geographic area are shown in Figure. 2 and described below.

Heavy Equipment

European beachgrass and lupine (30 acres) have invaded formerly open large parabolic dunes at the eastern portion of the parcel (beachgrass was planted here prior to 1948). These areas are relatively flat and suitable for operation of heavy equipment, which can access the site from the beach through an existing blowout (see "Heavy Equipment Fig. 2). The use of heavy equipment is beneficial in these backdune areas because invasive plant species can be buried below a layer of clean sand in a method known as soil inversion. Because sand may blow more readily along these restored parabolic dunes, buffer areas will be in place at the terminal ends of the parabolic dunes and upwind of any wetland swales to trap sand (sand fences may also be employed). Buffer areas would not be treated with heavy equipment (see below) and would be restored to dune mat using manual removal. It is likely that dune mat will also eventually become established in at least some of the areas restored to open sand, because 1) the large parabolic dunes are no longer migrating but have been stable at their terminal ends since the 1980s, and 2) the buried invasive plant species and associated litter layer would form a stable subsoil that will facilitate native plant establishment and growth. Heavy equipment will access the site by, "walking" the equipment down the beach and reaching the site through an existing blowout on the Long parcel. Additional access sites may be created by using heavy equipment to create a sloped area of the foredune. The foredune morphology would be restored after restoration is complete with the use of heavy equipment.

This type of restoration has been used successfully with several types of heavy equipment, locally in Humboldt and Del Norte Counties (Vaughn 2012, Pardini et al. 2018), and also at Pt. Reyes National Seashore. Both bulldozers and excavators have been used, separately and in combination. Excavators, if used, can dig the trenches needed to bury beachgrass and selectively remove vegetation, while bulldozers fill the trenches and then cover them with clean sand.

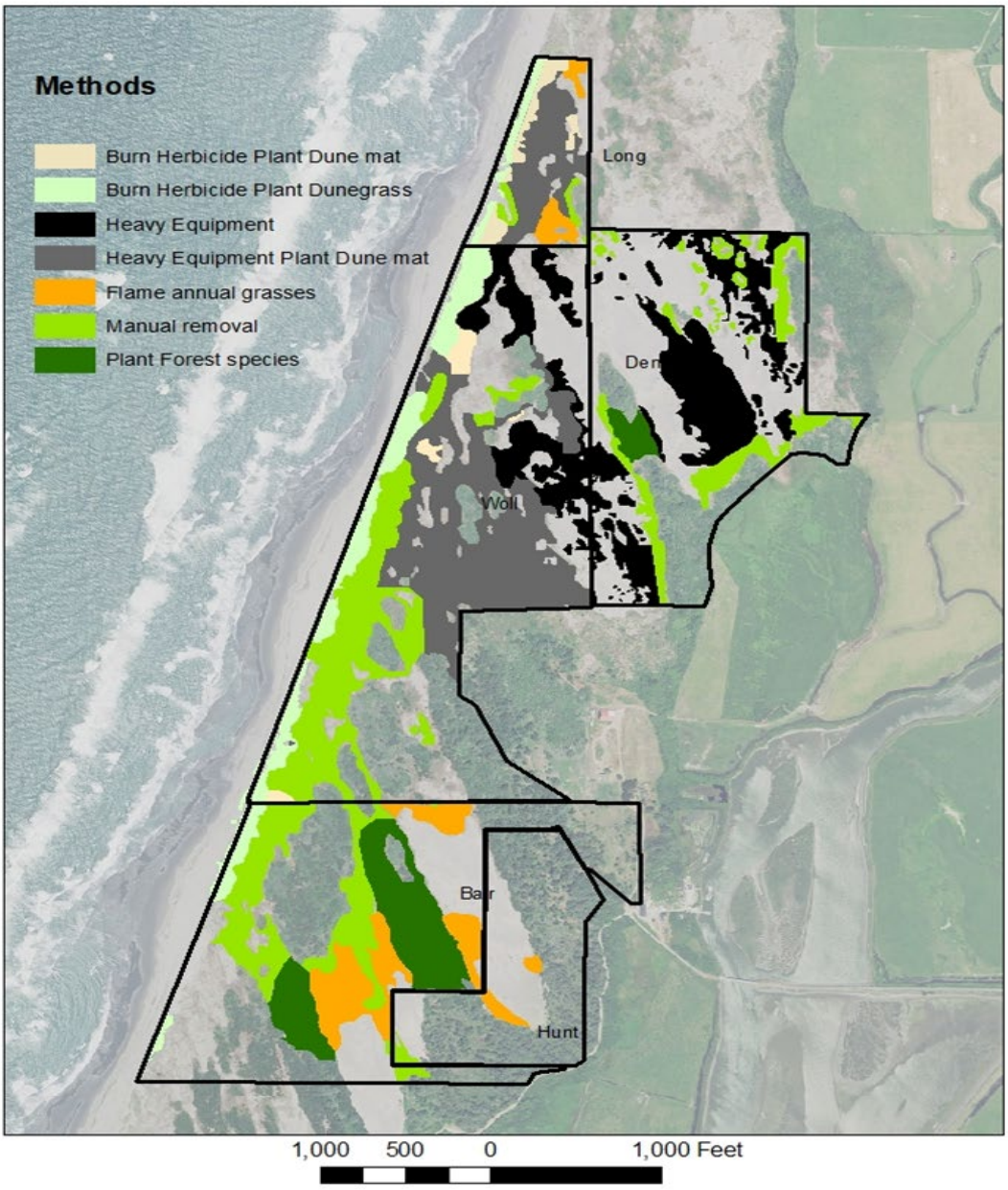

Figure 2. Location of Restoration Methods

In addition to the area to be restored to moving parabolic dunes, we propose to restore 32 acres colonized by yellow bush lupine in the central portion of the project area of the Woll and Demello parcels using heavy equipment, to be followed by planting of dune mat species (see "Heavy Equipment Plant Dune Mat" Fig. 20. Since these areas are not adjacent to existing moving parabolic dunes, they would be replanted to dune mat. Temporary stabilization methods, including use of biomimicry (shims used to simulate plant growth) or sand fencing would be used to slow sand movement while plants become established. This method has been used successfully on the East Coast and in Puerto Rico. Biomimicry measures are used upwind of plantings and slow sand movement. Biomimicry consists of sand fences or

shims, which can be raised up as needed as sand is deposited. Eventually, plants would colonize from the planted area upwind around shims or fences.

Prescribed Burning

Two methods of prescribed burning will be utilized in combination with other techniques to aid in restoration. Broadcast burning will be implemented in extant areas of European beach grass to remove a significant amount of vegetative biomass and decreases the amount of follow up manual labor and herbicide necessary when the grass resprouts. Broadcast burning will also be implemented in up to 120 acres of yellow bush lupine and coyote brush habitat. Using this technique in shrub habitat decreases the amount of biomass heavy equipment will need to bury and result in less impacts to dune topography. Pile burning is the second prescribed burning method. Manually removed European beach grass is stacked in piles and burned in place. The Refuge's existing Fire Management Plan allows for pile burning and will be revised to reflect broadcast burning prior to project implementation. Burn plans and smoke management plans will be completed prior to implementation and all burns will be carried out by CAL FIRE crews in fall, winter, or early spring months during an appropriate weather window.

Herbicides

Following prescribed burning application of the herbicide (e.g. imazapyr) on vigorously emerging post-burn resprouts will be utilized. This technique has been used successfully throughout California and Oregon to treat European beachgrass (Maslach 2006). This method would occur primarily in European beachgrass growing along the foredune zone on the Long, Woll, and Bair parcels (Fig. 11). A total of 13 acres of European beachgrass would be treated in this manner. Herbicide would be applied to new resprouts as necessary in the following summer/fall. The herbicide is applied through targeted spraying of plants using 4 gal backpack sprayers. When using imazapyr, the solution per 4 gal of water consists of 2% Imazapyr (10 oz.), 2 oz. of Liberate (adjuvant), 1 oz. competitor (adjuvant), and 4 oz. of blue dye. The dye allows for even coverage. In addition, spot treatment of beachgrass and iceplant would be carried out in the beachgrass-lupine-dune mat areas (7.9 ac). Application of herbicide would be allowed only after a pesticide use proposal (PUP) is approved consistent with the procedures outlined in the 2009 CCP/EA. The application of all herbicides would be in strict accordance to label specifications.

Manual Removal

Manual removal of yellow bush lupine has been ongoing in local dunes since the 1970s. Through a cooperative agreement, removal of mature lupines on the southern portion of the Bair parcel has resulted in low numbers of lupine in this area. However, native plants are not dominant because soils are still altered. Vegetation consists of a mix of native and non-native species that are not historic components of the dune mat community, including the shrub coyote brush, the rhizomatous fern *Polypodium calyrhiza*, a number of forbs such as California bee plant, and a suite of invasive annual grasses including ripgut brome and rattlensnake grass. These grasses are an ongoing source of wind-dispersed seed on to the Lanphere Dunes Unit to the south, necessitating continued management on that property.

Yellow bush lupine shrubs, when large, are chopped at the base of the plant and rarely resprout. Small plants are pulled up. Shrubs are piled and burned. After lupine removal, the litter/duff layer must be removed or buried under a cap of clean soil. Most of the dense lupine on the project site occurs in the central portion of the Bair, Woll, and Long parcels (Figure 7). The topography in the Bair parcel and south Woll parcel is variable and steep as it contains old stabilized trailing ridges of long-walled parabolic dunes, creating a ridge and trough topography that is generally not suitable for heavy equipment. The eastern portions of these areas are slated for conversion to forest (see below) but would still require the removal of reproductive lupine plants (which are not numerous as most of the shrub component has

converted to coyote brush). Clearing of brush and litter would be done by a combination of crews from the California Conservation Corps and High Rock Conservation Camp (CAL FIRE). The target restoration type for these areas is dune mat, which is adapted to low nutrient soils. We may also incorporate sterile rice straw into the surface to tie up Nitrogen in the litter layer (Corbin and D'Antonio 2004, Blumenthal et al. 2003). A total of 40 acres of lupine scrub would need to be cleared manually due to steep slopes (inaccessibility to heavy equipment) or because they are in buffer areas around swales or riparian areas. In addition, lupine would need to be cleared from an additional 24 acres to be converted to forest (see below). Lupine in these areas is relatively sparse.

Flaming and Manual Removal

Hand-held propane torches are used to kill invasive annual grasses when they occur densely. This method has been used successfully for many years at the Lanphere Dunes Unit. It is applied in late winter or early spring, before flowering of grasses. It is possible to work around native plants, although this method is usually supplemented with hand pulling of grasses. A total of 8.3 acres of Dune mat-annual grass would be treated in this manner.

Manual Removal, Flaming, and Herbicides

In areas of mixed lupine-beachgrass-dune mat where heavy equipment is not feasible, manual removal would be used for lupine and beachgrass, and spot spraying would be applied to beachgrass resprouts using the formula discussed above. In areas of mixed Dune mat-annual grass herbicides would be used on iceplant and flaming on annual grasses (see methods above). There are 7.9 acres of mixed lupine-beachgrass-dune mat.

Follow-up Treatments

Other than in heavy equipment removal areas, retreatment would be needed in the second year to remove any missed plants or new plants emerging from the seedbank. Retreatment would consist of a combination of manual removal, flaming, and herbicide treatments as discussed above.

Revegetation

Reintroduction of native species would occur in areas where dune mat or forest is the target vegetation, and when existing vegetation does not include adequate relict species following treatment. Table 1 summarizes the need for planting. Only perennial species such as beach bluegrass (*Poa macrantha*), beach strawberry (*Fragaria chiloensis*), and dune goldenrod (*Solidago spatulata*) would be planted as prior projects have demonstrated that annual species disperse readily onto a newly restored site.

Source of Propagules

The source of all dune mat and dunegrass propagules would be within the Humboldt Bay dune system, with first preference being the site itself or the adjacent Lanphere Dunes. All dunegrass propagules would be collected from a large inland population of *Elymus mollis* that is found on the Bair and Woll parcels. This site is behind the foredune and no longer receives active sand deposition, and *Elymus* has been declining naturally as a result of this and due to encroachment of yellow bush lupine. Over time, this area is expected to convert to dune mat. Dune mat propagules collected for planting on the restoration site would be either grown from seed or collected as divisions (portions of plants with roots and rhizomes) in areas where no endangered Humboldt Bay wallflower occur.

Table 1. Existing Vegetation and Need for Revegetation by Type

Existing Vegetation	*Target Vegetation*	*Relict Natives Present*	*Planting Need*
Lupine-dunegrass	Dunegrass	Yes	No
Dune Mat-annual grass	Dune mat	Yes	No
Beachgrass	Dunegrass	No	Dunegrass, dune mat

Existing Vegetation	*Target Vegetation*	*Relict Natives Present*	*Planting Need*
Beachgrass	Dune mat	No	Dune mat
Lupine	Dune mat	No	Dune mat
Lupine-Beachgrass	Dune mat	No	Dune mat
Beachgrass-Lupine-Dune mat	Dune mat	Yes	No
Lupine-Dune mat-Annual grass	Dune mat	Yes	No
Lupine-Beachgrass	Open sand	No	No
Lupine	Open sand	No	No
Lupine	Forest	Yes	Forest species

Seed Collection Methods

Seed would be collected by the California Conservation Corps (CCC), refuge staff, or contractors. All collectors would be trained in techniques and plant identification. No more than 30% of seeds produced by a given plant would be collected, and seed collection would be dispersed over a large area to avoid overharvesting. Species to be collected and timing of collection is shown in Table 2. Seed collection would occur in areas where no endangered Humboldt Bay wallflower occur. Hard-seeded species would be treated for dormancy (scarification and/or stratification, see Pickart and Sawyer 1998). Seeds would be grown out in pots by a contractor with experience growing dune plants. Seeds would be collected in summer months. A total of 49,000 plants are needed, for which a total of approximately 118,000 seeds would be collected.

Harvesting Propagules

Harvesting would be carried out by CCC or CAL FIRE crews under the direction of the restoration coordinator, or by a qualified contractor. For dunegrass, harvesting is done one or two days before planting. Shovels are used to harvest culms (stems) with attached rhizomes. Harvested plants are trimmed to reduce biomass and direct resources to the root/rhizome system. Plants are piled on tarps and carried to the planting site, where they are "heeled in" until planting. This consists of digging a trench and "planting" them temporarily, covering the based with sand. A total of 17,000 culms of dunegrass would be collected and planted.

Dune mat species (beach bluegrass and beach strawberry) are harvested the day of planting. Prior to harvesting, the plants are located and flagged by the restoration coordinator. Plants are dug up in such a way that only a portion of the plant is harvested, and both above and below ground portions of the plants are taken. Beach strawberry is clonal and entire ramets can be collected. Plants are placed in contractor bags and then carried to the planting site. If the distance is large, an ATV may be used on the beach to move plants. The restoration coordinator would give a demonstration of harvesting prior to starting. A total of 6,000 divisions of beach bluegrass and 6,000 divisions of beach strawberry would be harvested and planted. Harvesting would be carried out in winter months.

Table 2. Seed Collection Species and Collection Timing

Common Name	*Species*	*Collection Time*	*Number of Seeds*[1]
Beach pea	*Lathyrus littoralis*	June-July	12,600
Beach morning glory	*Calystegia soldanella*	July-August	13,000
Seaside daisy	*Erigeron glaucus*	August	12,000
Dune goldenrod	*Solidago spathulata*	August-September	8,000
Beach bur	*Ambrosia chamissonis*	August-September	24,000
Yellow sand verbena	*Abronia latifolia*	July-September	18,000

Common Name	*Species*	*Collection Time*	*Number of Seeds*[1]
Beach buckwheat	*Eriogonum latifolium*	August	16,000
Beach knotweed	*Polygonum paronychia*	August	6,051
Beach evening primrose	*Camissoniopsis cheirathifolia*	August-September	8,068

[1]Reflects rates of viability and empty seeds (Pickart and Sawyer 1998)

Planting

Planting would follow methods used in the past at the Lanphere adaptation site (Pickart 2017). In foredune areas, dunegrass and other species would be planted at 1 meter spacing. Prior to planting, the area would be flagged to indicate planting holes, using color coding for species. Stretches of foredune would be planted with three different combinations: dunegrass alone, a combination of bluegrass and dunegrass, and a combination of bluegrass, beach pea, and beach morning glory. Planting is done using a specialized shovel to open a hole, placing the division with care that roots are pointing down, then closing the hole and tamping. In the backdune, species would be planted at 4 meter spacing (one plant per $4/m^2$). Based on past projects, additional plants would volunteer. On the foredune a second goal is to slow sand movement. The non-native species sea rocket (*Cakile edentula* and *C. maritima*) are expected to establish voluntarily in the first year following removal in areas on or close to the foredune. This species does not persist and is useful to slow sand movement while native species are establishing (Pickart 2017). Planting would be timed after a steady pattern of winter rain has become established. If excessive sand movement occurs in the first summer after planting such that new plants are in danger of burial or excavation, temporary stabilization methods would be implemented as discussed above.

Forest Restoration

Seed Collection

Seed collection and propagation of forest species would be carried out by an experienced nursery/contractor. Some species may already be available as transplants from within the collection area, at a larger size. If so, these would be substituted for plants shown below. A total of 13 acres of forest would be planted. Density of planting would be one tree species and two understory species per $10m^2$. Canopy and understory species would be planted as a cluster. A total of 5,260 clusters would be planted. Species to be planted in the overstory are shown in Table 3. Since species' niches vary, the microsite needed for each species is also shown. Understory species are shown in Table 4.

Table 3. Species Collected and Planted for Overstory, and their Microsites

Species	*Number of Plants*	*Microsite*
Beach pine	4,208	All
Sitka spruce	1,052	Moist/shaded
Douglas fir	157	Dry
Cascara	105	Dry
Grand fir	105	Moist/shaded

Table 4. Species Collected and Planted for Understory, and their Microsites

Species	*Number of Plants*	*Microsite*
Evergreen huckleberry	2,104	All
Bearberry	526	Dry
Salal	1,052	Dry

Species	*Number of Plants*	*Microsite*
Twinberry	263	Moist
Flowering currant	263	Moist
Wax myrtle	1,052	Moist

Forest Planting

Planting would be carried out in the winter, during the rainy season. Planting would be done by refuge staff, contractors, the CCC, or CAL FIRE crews. Planting sites would be flagged in advance and color coded per species. The locations of planted clusters would be identified by GPS to monitor survivorship. Shovels are used to dig out holes deep enough to accommodate the root ball. Soil is then placed in any openings and tamped. Plants are clustered with one overstory and two understory species within an area of approximately 3 m^2. If any weedy species are present within this area, they would be pulled out. Planting locations would be visited twice in the first year to remove any competing species.

2.2 No Action

Under the No Action alternative, the Service would not remove invasive plant species from the Long, Woll, Demello, Hunt and Bair parcels on the refuge. These dunes would remain vegetated with invasive plant species.

Chapter 3. Affected Environment and Environmental Consequences

A full description of the affected environment can be found in the 2009 CCP/EA (https://www.fws.gov/refuge/Humboldt_Bay/what_we_do/conservation.html). A site-specific description of the parcels proposed for restoration as well as the potential environmental effects of the restoration is presented in this chapter. Table 5 explains which resources were eliminated from detailed evaluation. Continued coordination with the public since the completion of the 2009 CCP/EA and internal scoping has identified the following potential issues with respect to the Proposed Action:

1) Presence of the threatened Western Snowy Plover.

2) Presence of the endangered Menzies' wallflower and beach layia.

3) Presence of sensitive archeological resources.

4) Potential for destabilization of the foredune.

5) Loss of wetlands due to foredune destabilization

6) Use of herbicides on invasive species in upland areas.

Table 5. Resources Eliminated from Detailed Evaluation

Resource	*Rationale*
Water Quality	The proposed action would not have any direct or indirect effects on water quality.
Air Quality	The proposed action includes prescribed burns. The effects of prescribed burns are addressed in the 2009 CCP/EA. A burn plan would be completed and implemented collaboratively by CA Department of Fire

Resource	*Rationale*
	and USFWS. The proposed action would not have any additional or new effects to air quality.
Visitor Services	Following restoration these parcels would be considered for wildlife dependent recreation such as wildlife observation and photography. Prior to opening these areas to the public the Service would complete a compatibility review.
Fish and Wildlife	General effects to fish and wildlife are discussed in the 2009 CCP/EA. The proposed action would not have any additional or new effects to fish and wildlife resources.

3.1. Soils and Geomorphology

3.1.1. Affected Environment

The project site is located near the north end of the northern Humboldt Bay barrier, known as the North Spit. A north-south gradient of foredune elevation has been documented along the North Spit (McDonald 2015, Pickart and Hesp 2019) and the project site has a broader foredune than areas to the south (Figure 2), most likely due to a higher sediment supply resulting from proximity to the mouth of the Mad River (Pickart and Hesp 2019). In addition, a greater proportion of the overall site falls within high elevation classes compared with Lanphere, Ma-le'l and areas south (Figure3), offering an advantage in terms of wave overtopping and flooding due to increasing storminess and sea level rise.

The site consists of two episodes of dune migration. The older phase is stabilized by forest. In the northern portion of the site (Demello and north Woll) the newer phase almost completely covers the older, although there is a remnant forest "island" located on the Demello parcel. The newer phase, located on the western part of the site, includes a foredune zone, deflation basins, and large parabolic dunes. The foredune zone includes the foredune proper and a series of past and present blowouts and narrow parabolic dunes, most of which are today heavily vegetated and stabilized by invasive species. These small to intermediate parabolic dunes can be traced back to the 1948 air photo (Figure 4). At that time vegetation throughout the site was relatively sparse and composed of native species. The small parabolic dunes are still discernable in 1970 imagery, after the introduction of invasive yellow bush lupine to the site (Figure 5), but by the 1980s are covered with lupine (Figure 6). By 1970 the large parabolic dunes had become disconnected from the foredune zone (i.e. no sediment from the beach was reaching the parabolic dunes) (Figure 5). Currently all parabolic dunes are disconnected from the beach and foredune (Figure 7). In the most recent photo (Figure 7) large areas of the parabolic dunes in the north (Woll and Demello) are becoming stabilized by vegetation. All of the large parabolic dunes were still actively migrating in the 1948 photo, although *Ammophila* plantings were present on the central parabolic dune margin. By 2016 the northern large parabolic dunes were stabilized at their terminal ends, but the southern parabolic dunes on Bair and Hunt were still migrating. Recent research in the project vicinity, carried out under the "Climate Ready" sea level rise resilience and adaptation study funded by the State Coastal Conservancy, has shown that removal of invasive, overstabilizing vegetation on the foredune results in the re-connecting of the beach-foredune-backdune sediment budgets (Rader et al. 2018 and unpublished data). European beachgrass grows very densely relative to native foredune vegetation and traps sediment on the base or the seaward face of the foredune, preventing sediment from overtopping the foredune and possibly preventing landward translation of the foredune with sea-level rise. In a sea level rise adaptation experiment on the Refuge, removal of invasive European beachgrass and reestablishment of native species allowed for net deposition on the foredune after two winters marked by high water

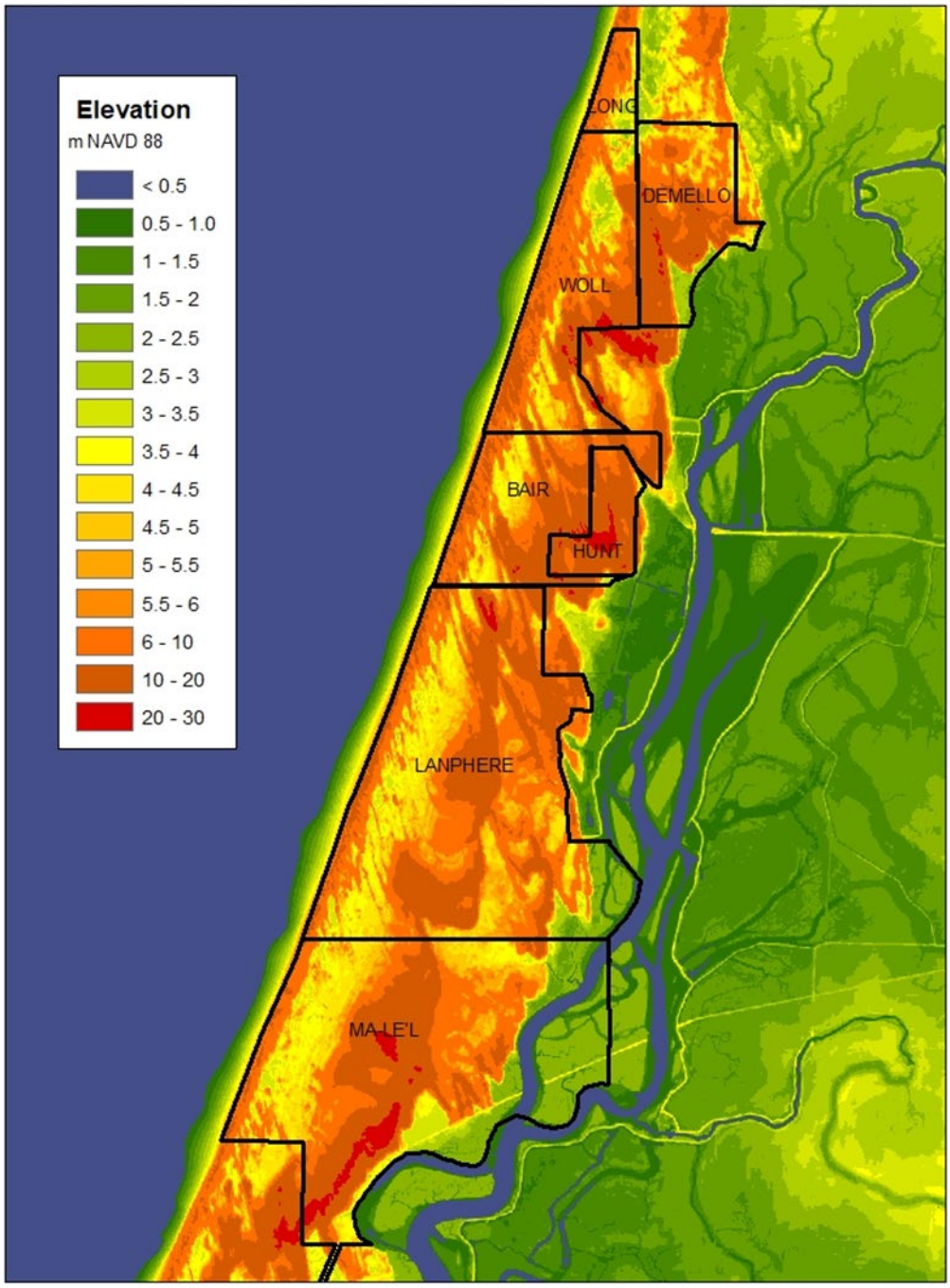

Figure 3. 2010 LiDAR DEM showing elevations of the project area (green/yellow lower, red higher).

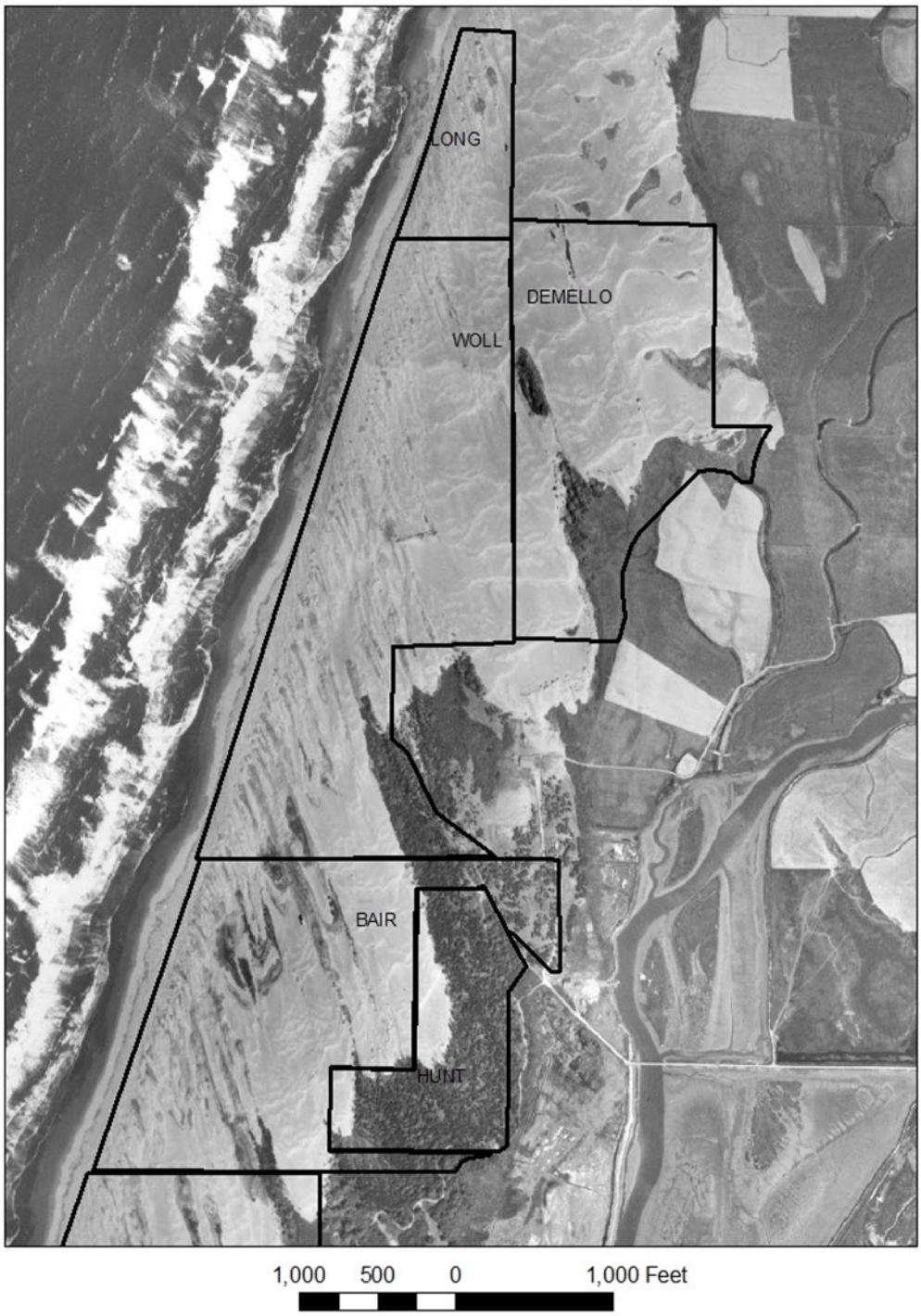

Figure 4. Aerial photo of the project site dated 1948.

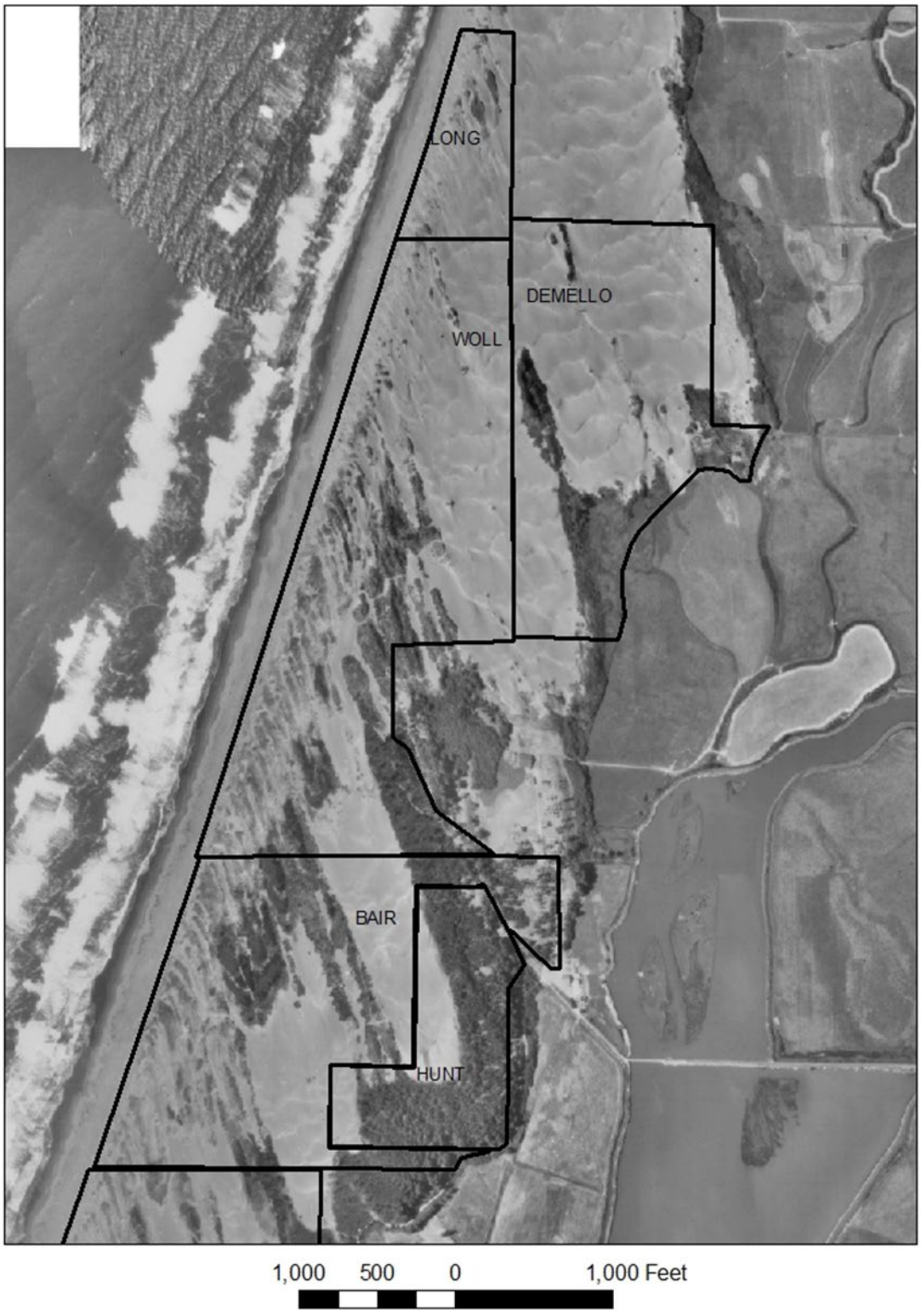

Figure 5. Aerial photo of the project site dated 1970.

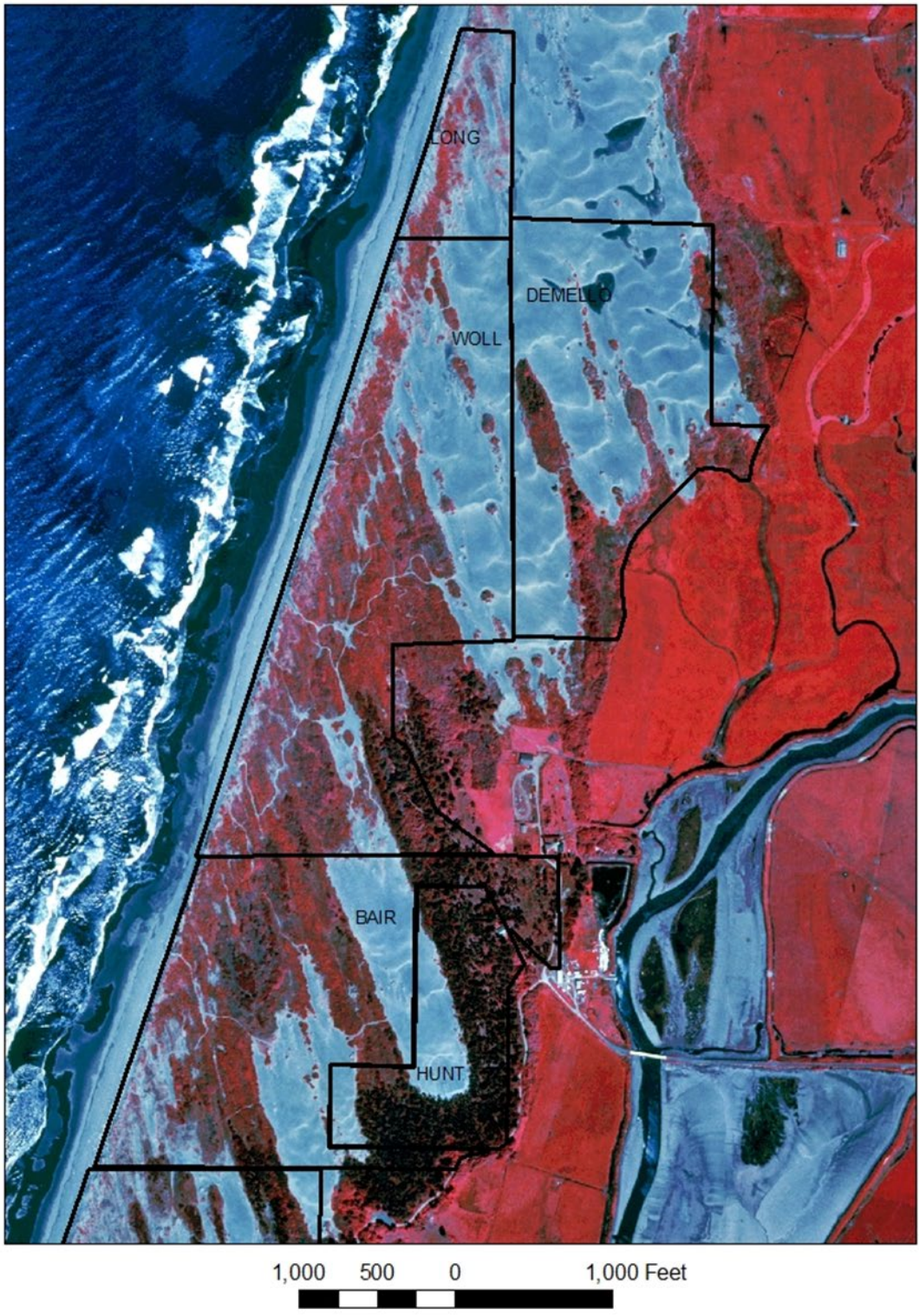

Figure 6. Color infrared image of the project site dated 1988.

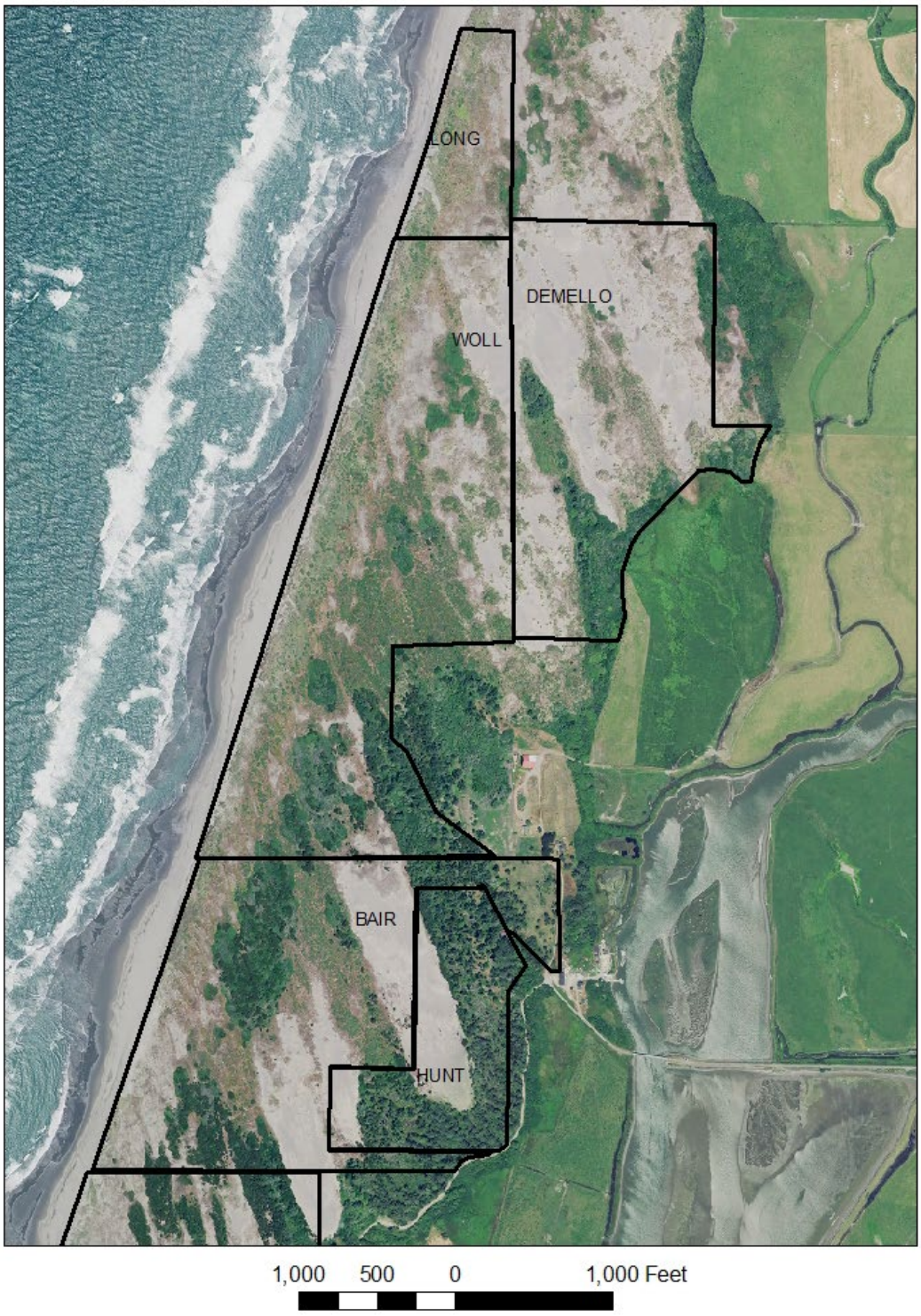

Figure 7. Color image of the project site dated 2016.

events and heavy beach and foredune erosion. Response to foredune scarping (cliffing) in the form of building of a scarp-fill ramp was more rapid and effective in restored versus unrestored areas, allowing sand to reach and rebuild the foredune. Since the adaptation site is located adjacent to the Bair parcel, the proposed restoration is expected to have similar positive results. Another component of the Climate Ready study measured beach-dune profiles over three years which demonstrated that restored foredunes along the upper North Spit have exhibited a resilient response to high water levels and scarping from storm surges (Pickart et al. 2018).

3.1.2. Environmental Consequences

Proposed Action

The proposed project is expected to cause changes in the topography of the site after invasive species are removed. On the foredune, based on geomorphic monitoring at other sites, some areas will see deflation and others deposition. At the Lanphere Sea Level Rise Adaptation Site, there was net deposition on the foredune 18 months after vegetation removal, although there were local areas of erosion as well as deposition (Rader et al. 2018). If storm surges with high wave energy occur during the restoration process, the foredune could potentially be scarped (cliffed). This type of erosion, caused by undercutting of the foredune at its base, occurs without respect to vegetation type (Pickart 2014b). Following erosion, a "scarp-fill ramp" builds up on the beach. Currently, much of the foredune is tall and steep, conditions under which a ramp may not reach a height sufficient to deliver sand to the top of the foredune. However, removal of invasive vegetation is expected to reduce the steepness of the foredune, and ramps will more easily form and heal scarps.

Over time, the proposed alternative is expected to restore the flow of sediment from the beach into the backdune. Through this process, in combination with intermittent blowouts that evolve into slowly stabilizing parabolic dunes, and by the transport of sand long distances during high wind events, the volume of the dune system would be maintained or increased as its profile translates upward and inland. This would maintain the storm-buffering effect of the foredune locally.

No Action

Under the No Action Alternative, European beachgrass would continue to overstabilize the foredune at the project site, restricting sand movement. The foredune would continue to be oversteepened and erode after significant storm events. With the increased frequency of significant erosional events predicted under climate change models, the European beachgrass dominated foredune might not be able to rebuild before additional erosion occurs, causing a retreat of the foredune face. This would not be balanced by the transport of sand over the crest of the foredune, and the foredune as a feature would be vulnerable to loss, allowing storm related overwash and erosion of backing dune features.

Over the long term, the amount of sediment moving inland would be reduced. If the foredune becomes eroded, and no sediments have been permitted to reach the backdune, these areas will be lower in elevation relative to rising seas than if sediment were reaching them. If the dunes eroded as far east as the deflation plain, there would be significant overwash and flooding in the lower lying deflation plain. This would result in a cumulative loss to the buffering ability of the dune system.

3.2. Plant Communities

3.2.1. Affected Environment

The present day vegetation of the project site in shown in Figure 8, and acreages are listed in Table 6. Descriptions of each vegetation type are below.

Table 6. Acreage of Existing Vegetation in the Project Area.

Vegetation Type	*Acres*
European beachgrass	24.5
Lupine with beachgrass	20.0
Yellow bush lupine	70.2
Yellow bush lupine with dunegrass	5.9
Yellow bush lupine with dune mat and annual grass	6.7
European beachgrass with yellow bush lupine and dune mat	1.3
Dune mat with annual grass	8.3
Dune mat (native)	39.0
Swale (native)	33.8
Riparian (native)	9.6
Forest (native)	33.4
Total vegetation:	252.7
Total vegetation to be restored/treated:	136.9

Upland Vegetation Types

Dune mat

Dune mat is the common name for the *Abronia latifolia-Ambrosia chamissonis* herbaceous alliance (Sawyer et al. 2009). This is a diverse plant community of low growing, herbaceous annuals and perennials that is found in semi-stable dunes on the west coast U.S. On the project site, the *Artemisia pycnocephala* association is prevalent in the north, and this association is dominated by a single species (*Artemesia pycnocephala*). The southern associations (found on the Bair parcel) are more diverse and abundant species include *Solidago spathulata, Eriogonum latifolia, Polygonum paronychia*, and *Poa macrantha*. Dune mat cover is variable, with a mean value of 40% (Pickart 2013).

European beachgrass

The *Ammophila arenaria seminatural* herbaceous alliance (European beachgrass swards) consists of dense stands of introduced, naturalized European beachgrass (Sawyer et al. 2009). This species was planted on the terminal lobe of one of the parabolic dunes some time before 1948, but also became established and spread along the beach side of the project site circa 1960s. As *Ammophila* spreads, cover values generally reach 100%.

Yellow bush lupine

Lupinus arboreus seminatural shrub alliance (Yellow bush lupine scrub) is dominated by yellow bush lupine and coyote brush (*Baccharis pilularis*) (Sawyer et al. 2009). Yellow bush lupine is an ecosystem engineer that elevates soil nitrogen and facilitates secondary invaders (Pickart et al. 1998). Over time, yellow bush lupine may become secondary or absent, and a novel scrub community with both native and non-native species occurs These include coyote brush, *Polypodium calyrhiza*, *Scrophularia californica*, relict dune mat species, and invasive annual grasses such as *Aira praecox*, *Briza maxima*, and *Bromus diandrus*. Cover can reach 100%.

Iceplant

Iceplant mats (*Mesembryanthemum* spp.-*Carpobrotus* spp. Herbaceous Semi-natural Alliance) consist of dense mats of iceplant (in the project site, *Carpobrotus chilense* x C. edulis). Cover is up to

100% (Sawyer et al. 2009). In the project site these occurrences are scattered, and are subordinate to the Yellow Bush Lupine and European beach grass vegetation types. For this reason they are not mapped.

Dune Forest

Beach pine forest (*Pinus contorta* ssp. *contorta* forest alliance) (Sawyer et al. 2009) can be found in the southern part of the project site. This forest type also includes the Sitka spruce association, in which spruce is dominant. The understory can vary from low growing mats of bearberry (*Arctostaphylos uva-ursi*) to dense shrubs such as evergreen huckleberry (*Vaccinium ovatum*).

The remaining upland vegetation types shown in the vegetation map are mixtures of the above types that are mapped together due to their complexity.

Wetland Vegetation Types

Swales

Swale (also known as hollow or slack) is a colloquial name for the wetland vegetation found in deflation basins. There are several vegetation alliances that can occur in swales. The most common herbaceous vegetation is the *Carex obnupta* herbaceous alliance (Sawyer et al. 2009). Slough sedge (*Carex obnupta*) occurs in very dense stands, usually of 100% cover, although other wetland species, both native and non-native can co-occur. Woody vegetation in swales includes Hooker's willow (*Salix hookeriana*), beach pine (*Pinus contorta* ssp. *contorta*), California blackberry (*Rubus ursinus*) and wax myrtle (*Morella californica*). In the project site, the southern areas have more mature swales with woody vegetation, and northern swales tend to be herbaceous.

Riparian Forest

A fringing riparian forest occurs along the ecotone between the dunes and the agricultural land (former salt marsh) on the Demello parcel. This forest is a mixture of red alder (*Alnus rubra*) and Hooker's willow. The riparian forest is not part of the restoration plan.

3.2.2 Environmental Consequences

Proposed Action

Upland Vegetation Types

In the short term, the Proposed Action would result in a reduction or loss of vegetative cover after invasive species are removed and before revegetation is mature. Some areas of native vegetation may become buried by mobilizing sand, although this will be minimized by temporary stabilizing measures. Based on past projects, over time, open sand will decrease. Revegetation will reduce the amount of time when open areas are subject to wind erosion. Natural blowouts may form in the foredune, as is typical of a high energy coastline (Hesp 2002). These blowouts will allow delivery of sand and an increase in volume of the backdune and increase heterogeneity of topography. Over time species composition will shift to later successional species in the backdune, but blowouts will provide areas of open sand where early successional species can reestablish, maintaining high levels of diversity. The parabolic dune in the north will potentially activate at its western end, resulting in the expansion of seasonal wetlands. Seasonal wetlands are both created by the migration of dunes, and buried by their advance. Over time, as can be seen in a study documenting change to dune topography since the 1930s (Pickart and Hesp 2019), wetlands shifted spatially but increased in overall area dramatically.

Landscape connectivity would be enhanced through the Proposed Action, as the restored dunes on the project site become connected to the adjacent native foredune to the south.

Non-target effects of herbicides will be minimized by careful application. Use of dye allows the applicator to carefully track where herbicide is applied and avoid any native plants. In similar past

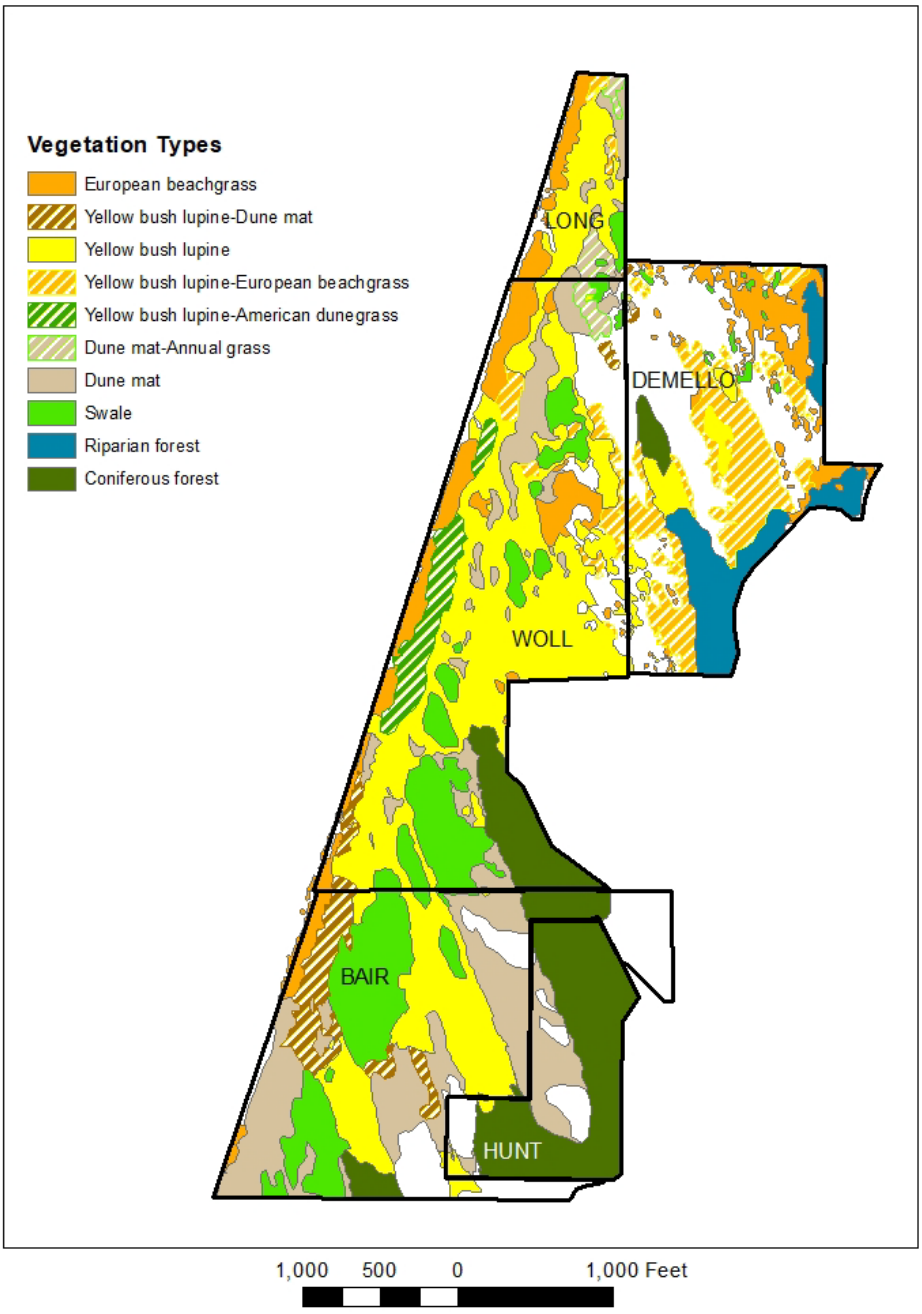

Figure 8. Present Day Vegetation Types of the Project Site

projects only minimal non-target effects were observed. Spraying is done in low wind conditions to minimize drift. Native plants have recolonized within a year after spraying in past projects.

Adaptive management would be practiced throughout the course of the project. This would allow for any needed, corrective actions to occur. An example of such actions could be additional plantings if cover doesn't progress as expected.

Wetland Vegetation Types (Swales)

The dunes at the site of the Proposed Action have been overstabilized by invasive vegetation and no longer support the natural processes present on the Lanphere and Ma-le'l Dunes to the south. In a natural system, swales are dynamic features that expand and recede depending on the processes acting around them. At their seaward end, swales may become buried by the tongues of sand (new parabolic dunes) originating from foredune blowouts. These parabolic dunes eventually stabilize, creating a transitional edge between the upland parabolic dunes and the wetland swales. The wetland upland ecotone, a zone generally known for high species diversity (Kark et al. 2002), is increased. At their eastern margins, the swales in a naturally functioning dune system expand as the deflation plain migrates eastward behind the larger moving dunes. For example, the acreage of wetlands on the Lanphere Dunes Unit increased from 9 to 87 acres between 1948 and 2016 as the moving dunes migrated eastward (Pickart and Hesp 2019). However, these processes are not currently functioning at the site of the Proposed Action. The swales are static and not increasing in area over time. The proposed action will cause the swales to become more dynamic like those to the south. As swales migrate, the vegetation changes at the site of deflation, beginning with early successional species and evolving to shrubs and trees. This creates added genetic, species, and structural diversity and improves habitat values.

No Action

Upland Vegetation Types

Under the No Action Alternative, invasive species would continue to dominate the project site. In the short term, this would continue to cause very low biological diversity, causing additional loss of native plants including endangered Humboldt Bay wallflower and beach layia. Invasive species would also continue to spread in the large moving parabolic dune, causing it to become stable.

In the long term, the foredune at this site would potentially be eroded (rather than migrate) due to climate-change induced storms and sea level rise. This will negatively impact the semi-stable dunes behind the foredune. In the southern portion of the site, these dunes support rare plant communities and endangered plants, which would be exposed to the erosive actions of tidal surges and waves.

Wetland Vegetation Types

The No Action Alternative would have no short-term impacts on wetlands. Because the dunes are overstabilized seaward of the wetlands, the wetlands would continue to lack the dynamic properties of swales that are found in native areas. These properties include disturbance from deflation and deposition, which cause wetland/upland boundaries to fluctuate, increased edge and greater species diversity. In the long term, wetlands would be unable to migrate with sea level rise and would become eroded and/or subject to salt water intrusion, changing their vegetation type to brackish or saline.

3.3. Threatened and Endangered Species

3.3.1. Affected Environment

Western Snowy Plover

The western snowy plover nests adjacent to or near tidal waters with a breeding range that extends along the coastal beaches from the southern portion of Washington State to southern Baja California, Mexico (USFWS 1993). The breeding season extends from March 1 through September 15. Adults and young forage on invertebrates along intertidal areas, along beaches in wet sand and surf cast kelp, in foredune areas of dry sand above the high tide, on salt pans, and along the edges of salt marshes and salt ponds. The snowy plover is primarily a run-stop-peck type of forager. Human disturbance and predation, combined with the loss of nesting habitat to the encroachment of introduced beachgrass (*Ammophila arenaria*), have led to an overall decline in the breeding and wintering population of the

western snowy plover along the northern California coastline. These factors, as well as others associated with denser human population areas (e.g. shoreline hardscaping, development, salt pond operation) resulted in the Pacific coast population of the western snowy plover being federally-listed as threatened in 1993. Western snowy plover breeding population in Humboldt County (Recovery Unit 2) ranged in size between 19-74 breeding adults between 2001 and 2016 (Colwell, et. al., 2017). Breeding concentrations near the project area are at Clam Beach (approx. 3 miles north) and South Spit (approx. 13 miles south). One nest was documented within 1 mile of the project area during this timeframe. Wintering populations are in loose flocks and tend to occur in the same general location as their breeding grounds (USFWS 1993).

Menzies' Wallflower

The Menzies' wallflower is abundant in the southwest corner of the Bair parcel, which has been managed for some time. North of this area it is restricted to several small isolated occurrences (Figure 9). The population on Bair was estimated at approximately 13,000 individuals (over 2 cm in diameter) in 2015. In contrast, there are probably fewer than 20 individuals in most of the Woll occurrences. The wallflower is a monocarpic perennial that lives for an average of 3 years as vegetative rosette before reproducing and dying. Individuals may become infected with white rust disease, which can suppress reproduction. Wallflower populations have been increasing on the North Spit since a decadal monitoring project began in 1988 (Sawyer and André 1990), from approximately 20,000 individuals to over 130,000 in 2015 (Pickart et al. 2018). Wallflowers are restricted to dune mat and favor vegetation with openings, responding well to restoration. More recently, it has been shown that assisted dispersal can greatly increase population growth (Pickart et al. 2018).

Beach Layia

Beach layia is a diminutive annual that can occur in very large numbers, although its populations are subject to fluctuations that track with annual rainfall (USFWS 2018). A 2017 survey of the North Spit by Laurel Goldsmith with the U.S. Fish and Wildlife Service estimated a total of over 19 million individuals (USFWS 2018). Like the wallflower, beach layia is restricted to the dune mat community. It has been shown to rebound after restoration through the removal of invasive species (Wheeler 2014). On the project site, beach layia is found in remnant areas of dune mat, with the greatest number in the southwest corner of the Bair parcel, which has been partially restored (Figure 10).

There have not been any official surveys of other special status species on the project site. *Gilia millefoliata* has been observed on the Bair parcel. A survey for other special status species will be conducted prior to restoration.

3.3.2. Environmental Consequences

Proposed Action

Western Snowy Plover

The Proposed Action would not affect the Western Snowy Plover. There is no potential habitat on the project site, including access corridors. However, an experienced biomonitor will survey beach access corridors prior to mobilization/demobilization. If a nest is documented, a buffer will be established and access will occur during low tide periods

Menzies' Wallflower and Beach Layia

Under the proposed action, individual of Menzies' wallflower will be marked and avoided. Some individuals of the wallflower and beach layia may be impacted by manual restoration activities, but overall the species will greatly benefit from the large increase in available habitat. Over time, populations of both species are expected to significantly increase. The Proposed Action would prevent further spread of the invasive species and subsequent loss of endangered plants on the site.

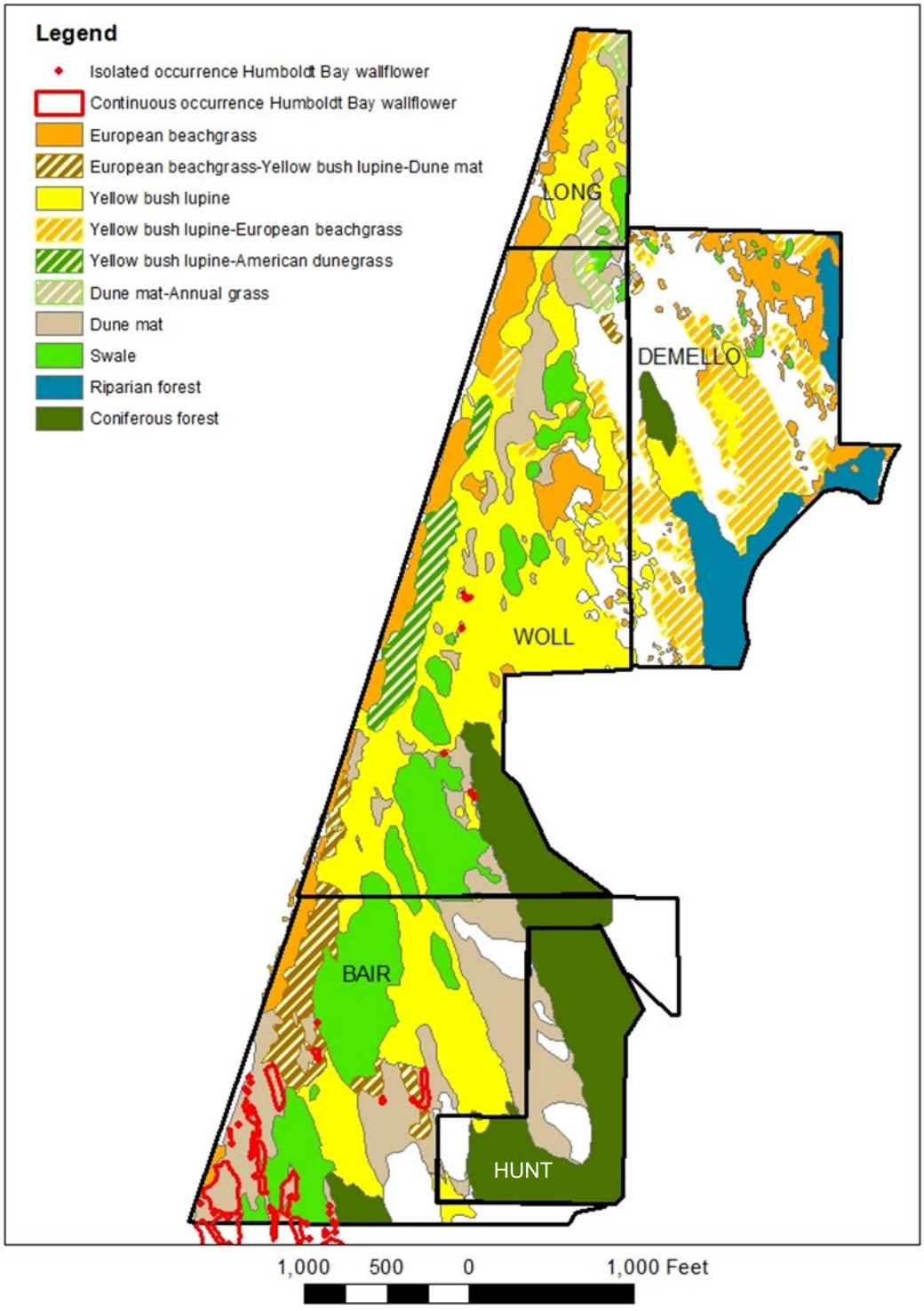

Figure 9. Distribution of Endangered Menzies' Wallflower in relation to vegetation type, as mapped by USFWS in 2015.

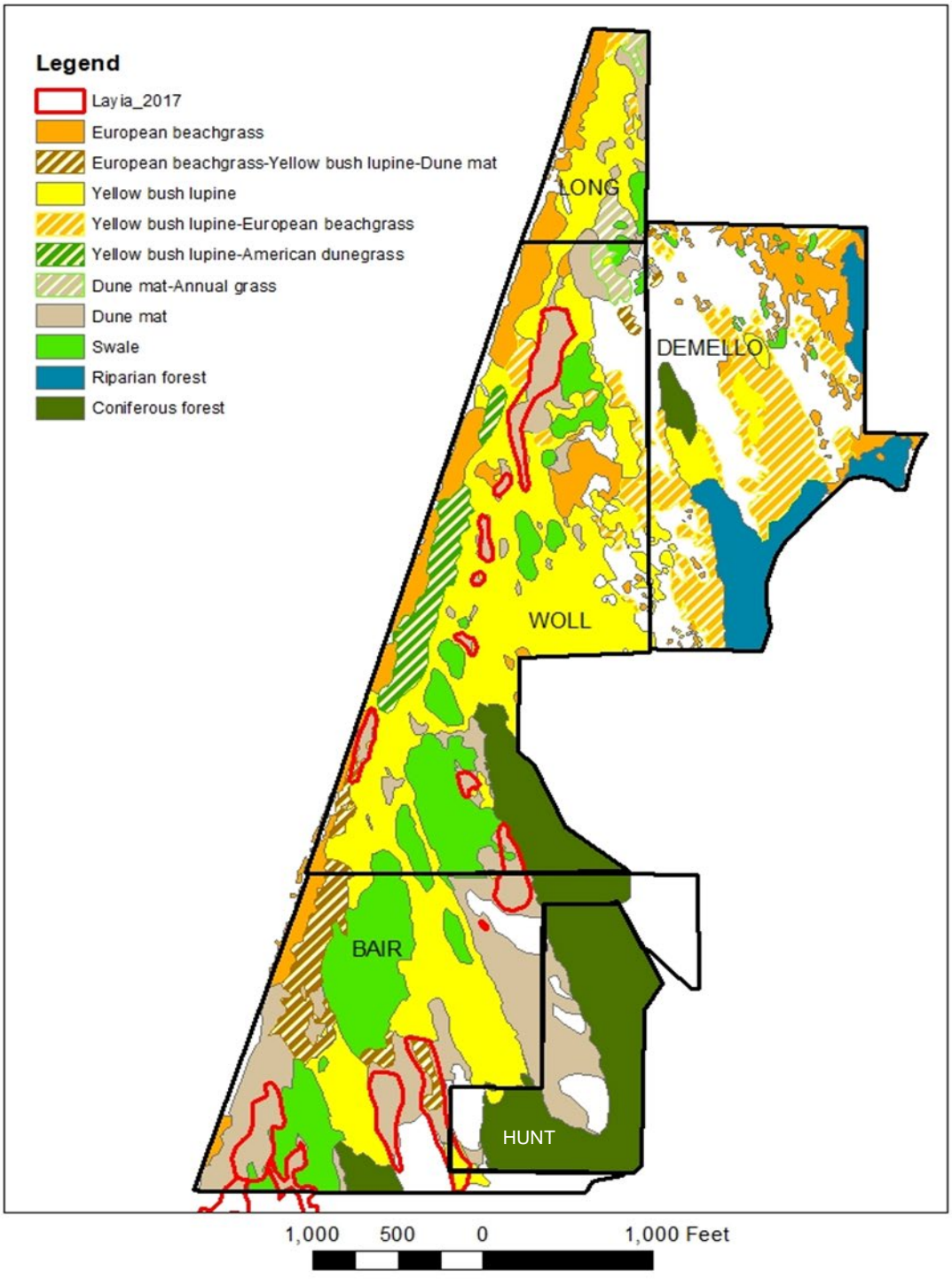

Figure 10. Distribution of Endangered beach layia in relation to vegetation type, as mapped by USFWS in 2017.

No Action

Under the No Action Alternative, invasive species would continue to spread, and would eventually outcompete the endangered Menzies' wallflower and beach layia occurring in the transitional area on the southern portion of the site. The invasive species would continue to move into the remaining dune mat areas elsewhere, causing loss of potential habitat. The No Action Alternative would have no effect on the Western Snowy Plover, which does not nest at the project site.

3.4. Cultural Resources

3.4.1. Affected Environment

The project site lies within the ancestral territory of the Wiyot Tribe, and cultural resource surveys of the Lanphere and Ma-le'l dunes to the south have revealed extensive cultural sites. In addition, there are culturally significant vegetation types present in the project area. A survey of the project site will be conducted in coordination with Wiyot tribal governments prior to restoration.

3.4.2. Environmental Consequences

Proposed Action

The Service has conducted a review of the cultural resource files in its Portland Cultural Resource Team offices and has found that no surveys have been conducted and no sites have been recorded within the area of the Proposed Action. The Service has initiated a request for Section 106 consultation with the California State Historic Preservation Officer and the local tribes, to identify and address issues of concern. A cultural resources survey of the site of the Proposed Action will be carried out prior to any work occurring. The following is standard procedure that would be followed in the event cultural resources are encountered. If any issues of concern are identified during consultation, the Service will engage a qualified archaeological technician to monitor all initial ground-disturbing activities agreed upon with the local tribes as areas of concern. If any cultural materials, sites, or properties should be discovered, a qualified archaeologist will evaluate the finds and appropriate protection measures consistent with the requirements of 14 California Code of Regulations § 1504.5(f) will be taken, if necessary. In the event that any human remains are encountered or in the event that unassociated funerary objects, or grave goods are discovered, work in the immediate vicinity of the discovery, other than non-disturbing documentation, shall cease and the Service shall comply with applicable State laws (14 California Code of Regulations § 15064.5(e), Health & Safety Code § 75050.5, and Public Resources Code § 5097.98), Native American Graves Protection and Repatriation Act (NAGPRA) as outlined at 43 CFR 10 and, Archaeological Resources Protection Act (ARPA) at 43 CFR 7.

No Action

The No Action Alternative would have no impacts on Cultural Resources in the short-term, because no ground disturbing activity would occur. In the long-term, due to changes anticipated in the Physical Environment as the result of the No Action Alternative (see below), the vulnerability of Cultural Resources that occur inland of the project site to exposure and their loss to erosion could potentially be accelerated.

3.5. Social Environment

3.5.1 Affected Environment

The site of the Proposed Action is located within Humboldt Bay National Wildlife Refuge. The nearest private residence is 0.2 miles to the east, and is separated from the project site by stabilized wetlands and forest. Lanphere Road, a private road that leads to the refuge office, and private residences are all separated from the project site by stabilized dune forests.

3.5.2 Environmental Consequences

Proposed Action

Under the Proposed Action residents of Arcata to the east and south and Manila to the south or Mad River to the north could potentially see smoke from prescribed burns or pile burning. Fires would be of short duration, and would follow the approved burn plan coordinated with the Air Quality District. Collaboration with CAL FIRE and USFWS Fire Management Officers will occur to minimize and mitigate effects. The increased flow of sand or potential for blowouts resulting from the Proposed Action would be highly localized. There are no residences or communities that would be affected by increased sand movement. The stabilized, forested dunes ultimately separate all of the processes to the west from any residences to the east. In the long term these communities would potentially benefit from increased resiliency to sea level rise

As described under Soils and Geomorphology, restoring the flow of sediment from the beach into the dunes is expected to ultimately maintain the storm-buffering effect of the foredune, resulting in a more resilient barrier system that would continue to protect the Bay.

No Action

Under the No Action alternative, resiliency would not be added to the dune system. Residences close to the project site would likely be more vulnerable to sea level rise.

3.6 Cumulative Effects

The cumulative effects of dune habitat restoration were addressed in the 2009 CCP/EA. The Service concluded that the cumulative impacts of restoration and enhancement actions on dune mat/foredune grassland and dune swale (freshwater, seasonal wetland) plant communities was expected to be cumulatively beneficial. The Proposed Action is consistent with effects described in the 2009 CCP/EA. The Proposed Action would contribute to the cumulatively beneficial effects to plant and animal communities and to the dune ecosystem overall.

Chapter 4. Consultation and Coordination

4.1. Public Review

The draft EA will be available for a 30-day public review. Substantive comments received on the draft EA will be used to prepare a final EA.

4.2. Agencies and Persons Consulted

U.S. Fish and Wildlife Arcata Office .

Greg Gray, Coastal Program

Laurel Goldsmith, Fish and Wildlife Biologist, Endangered Species Program

Susie Tharrat, Endangered Species Program

U.S. Fish and Wildlife Service - Fire

Jebediah Koons, Fire Management Officer

Humboldt Dunes Cooperative

Friends of the Dunes

Suzie Fortner, Executive Director

California Native Plant Society

Carol Ralph, President

California Coastal Commission

Mark Delaplaine

California Coastal Conservancy

Su Corbaley

Bear River Band of the Rohnerville Rancheria

Erika Cooper

Blue Lake Rancheria Tribe of California

Janet Eidsness

Wiyot Tribe, Table Bluff Reservation

Ted Hernandez

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Attachment 1

California Environmental Quality Act, Initial Study Checklist

CEQA Environmental Checklist

PROJECT DESCRIPTION AND BACKGROUND

Project Title:	Restoration of the northern dune additions to Humboldt Bay National Wildlife Refuge
Lead agency name and address:	
Contact person and phone number:	
Project Location:	Humboldt Bay NWR
Project sponsor's name and address:	US Fish and Wildlife Service, 6800 Lanphere Rd., Arcata CA 95521
General plan description:	NR
Zoning:	NR/A,B,W
Description of project: (Describe the whole action involved, including but not limited to later phases of the project, and any secondary, support, or off-site features necessary for its implementation.)	Restore a total of 300 acres of coastal dunes located north of the Lanphere Dunes Unit of HBNWR through the removal of European beachgrass (*Ammophila arenaria*), yellow bush lupine (*Lupinus arboreus*), iceplant (*Carpobrotus edulis* x *C. hilense*), and invasive annual grasses followed by revegetation with native species. Restoration includes: 1. Restore 12.9 acres of foredune currently invaded by European beachgrass to a mix of dune mat and native dunegrass, using a combination of removal methods (prescribed burn, herbicides, manual removal) and replant with harvested divisions of dunegrass and beach bluegrass, and ropagated plants of beach pea and beach morning glory; 2. Restore 72.6 acres of backdune area currently invaded by European beachgrass, yellow bush lupine, iceplant, annual grasses and pampas grass to dune mat using a combination of removal methods (manual removal, prescribed burn, flaming, herbicides, heavy equipment) and replant with propagated plants of a variety of dune mat species; 3. Convert 30 acres of backdune currently invaded by European beachgrass and yellow bush lupine to open sand using heavy equipment (soil inversion); 4.Convert 21.4 acres of backdune currently invaded by yellow bush lupine to dune forest by planting with understory and overstory native species.
Surrounding land uses and setting; briefly describe the project's surroundings:	The project site is located north of the Lanphere Dunes Unit, within Humboldt Bay National Wildlife Refuge. To the north are private, unoccupied coastal dune parcels and Mad River Beach County Park. East of the project and separated by a buffer zone are a riparian strip, and then agricultural lands used for grazing and haying, and several residences. West of the project is the Pacific Ocean, and south of the project is the Lanphere Dunes Unit, HBNWR.

Other public agencies whose approval is required (e.g. permits, financial approval, or participation agreements):	The California Coastal Commission requires a consistency determination.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project. Please see the checklist beginning on page 3 for additional information.

	Aesthetics		Agriculture and Forestry	X	Air Quality
X	Biological Resources	X	Cultural Resources	X	Geology/Soils
X	Greenhouse Gas Emissions		Hazards and Hazardous Materials		Hydrology/Water Quality
	Land Use/Planning		Mineral Resources		Noise
	Population/Housing		Public Services		Recreation
	Transportation/Traffic		Utilities/Service Systems		Mandatory Findings of Significance

DETERMINATION:

On the basis of this initial evaluation:

X	I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.
☐	I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.
☐	I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.
☐	I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.
☐	I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required

Signature:	**Date:**
Printed Name:	**For:**

CEQA Environmental Checklist

Dist.-Co.-Rte.	P.M/P.M.	E.A.

This checklist identifies physical, biological, social and economic factors that might be affected by the proposed project. In many cases, background studies performed in connection with the projects indicate no impacts. A NO IMPACT answer in the last column reflects this determination. Where there is a need for clarifying discussion, the discussion is included either following the applicable section of the checklist or is within the body of the environmental document itself. The words "significant" and "significance" used throughout the following checklist are related to CEQA, not NEPA, impacts. The questions in this form are intended to encourage the thoughtful assessment of impacts and do not represent thresholds of significance.

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
I. AESTHETICS: Would the project:				
a) Have a substantial adverse effect on a scenic vista	☐	☐	☐	X
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway	☐	☐	☐	X
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	X
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	X
II. AGRICULTURE AND FOREST RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment Project; and the forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	X
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	X

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	X
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	X
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☐	X

III. AIR QUALITY: Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:

a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	X
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	X	☐
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non- attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	X	☐
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	X	☐
e) Create objectionable odors affecting a substantial number of people?	☐	☐	X	

The Proposed Action would include burning of invasive vegetation that would release PM10 for which Humboldt and Del Norte counties are classified as nonattainment. Burning invasive vegetation would be done only with a burn and smoke management plan that is approved by the North Valley Unified Air Pollution Management District.

IV. BIOLOGICAL RESOURCES: Would the project:

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	X	☐

All individuals of the endangered Humboldt Bay wallflower found adjacent to the impact area or in the transition area would be flagged and avoided, and barriers erected if sand movement could potentially affect any plants. Individual beach layia may be impacted. Other special status species are not known to be present. The project will result in increased habitat for all of these species, which will be reintroduced to the site after restoration.

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?	☐	☐	☐	X

Riparian habitat is present to the east of the project Site. A buffer area will be maintained and only Manual removal will occur within the buffer area.

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	X	
Swales (seasonal wetlands) occur within the project site. Buffer areas will be established around existing wetlands, and only manual removal will occur in buffer areas. The project is likely to result in burial of some areas by moving sand and creation of new areas where sand is ablated. Dune swales are naturally dynamic and migrate with moving dune features.				
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	X
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	X
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	X
V. CULTURAL RESOURCES: Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	X
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	X	
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	X
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	X

A cultural resource survey will be conducted prior to the start of the project, and a cultural monitor will be present during any excavation work by heavy equipment. If any cultural materials, sites, or properties should be discovered, a qualified archaeologist will evaluate the finds and appropriate protection measures consistent with the requirements of 14 California Code of Regulations § 1504.5(f) will be taken, if necessary. In the event that any human remains are encountered or in the event that unassociated funerary objects, or grave goods are discovered, work in the immediate vicinity of the discovery, other than non-disturbing documentation, shall cease and BLM shall comply with applicable State laws (14 California Code of Regulations § 15064.5(e), Health & Safety Code § 75050.5, and Public Resources Code § 5097.98), Native American Graves Protection and Repatriation Act (NAGPRA) as outlined at 43 CFR 10 and, Archaeological Resources Protection Act (ARPA) at 43 CFR 7.

VI. GEOLOGY AND SOILS: Would the project:

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	X
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42?	☐	☐	☐	X
ii) Strong seismic ground shaking?	☐	☐	☐	X
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	X
iv) Landslides?	☐	☐	☐	X
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	X	

There is no topsoil on the dunes. Changes in dune topography are expected following removal of invasives species. The foredune will become less steep and more rounded. New deflation areas may occur resulting in the formation of new seasonal wetlands, and some burial may occur in existing wetlands due to sand movement. The project is located on a wildlife refuge managed for ecological processes and biodiversity, and no infrastructure would be affected.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	X
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	X

VII. GREENHOUSE GAS EMISSIONS: Would the project:

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	X	
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☐	X

Greenhouse gases would be emitted during burning of beachgrass/brush, through the operation of heavy equipment and during transport of people, supplies and equipment to the site. These would be short-term emissions limited to the project implementation phase.

VIII. HAZARDS AND HAZARDOUS MATERIALS: Would the project:

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	X
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	X
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	X

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	X
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	X
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	X
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	X
IX. HYDROLOGY AND WATER QUALITY: Would the project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	X
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	X
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☐	X
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☐	X
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	X
f) Otherwise substantially degrade water quality?	☐	☐	☐	X

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	X
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	X
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	X
j) Inundation by seiche, tsunami, or mudflow	☐	☐	☐	X
X. LAND USE AND PLANNING: Would the project:				
a) Physically divide an established community?	☐	☐	☐	X
b)Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	X
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	X
XI. MINERAL RESOURCES: Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	X
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	X
XII. NOISE: Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	X
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	X
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	X

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	X
) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	X
XIII. POPULATION AND HOUSING: Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	X
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	X
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	X
XIV. PUBLIC SERVICES:				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:	☐	☐	☐	X
Fire protection?	☐	☐	☐	X
Police protection?	☐	☐	☐	X
Schools?	☐	☐	☐	X
Parks?	☐	☐	☐	X
Other public facilities?	☐	☐	☐	X

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
XV. RECREATION:				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	X
XVI. TRANSPORTATION/TRAFFIC: Would the project:				
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	☐	☐	☐	X
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?	☐	☐	☐	X
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	X
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	X
e) Result in inadequate emergency access?	☐	☐	☐	X
f) Conflict with adopted policies, plans or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?	☐	☐	☐	X
XVII. UTILITIES AND SERVICE SYSTEMS: Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	X

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant Impact	No Impact
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	X
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	X
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	X
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	X
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	X

XVIII. MANDATORY FINDINGS OF SIGNIFICANCE

a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	X
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	X
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	X