PORE 7151
PEPC 13222

ERRATA
Environmental Assessment
Abbotts Lagoon Area Dune Restoration Plan

Point Reyes National Seashore
June 2009

Announcement of availability of the Abbotts Lagoon Area Dune Restoration Plan EA on the park web site or hardcopy by request was sent to a mailing list of approximately 300 groups and individuals on February 2, 2009. This mailing list is used (and added to as requested by the public) when EAs are made available for public review. The project EA including all its appendices, graphics, and other supporting documentation was posted on the Point Reyes National Seashore website (http://www.nps.gov/pore/parkmgmt/planning_dunerestoration.htm) to which reviewers and interested parties were directed. Printed copies of the EA were mailed to all agencies, and 15 digital versions were provided to the California State Clearinghouse for review.

The NPS conducted public review for 45 days, with the comment period ending on March 20, 2009. Seven (7) comment letters were received during this open comment period. On February 13, 2009, the State Clearinghouse initiated a 30-day comment period for State agency review (SCH#2009024003). The State Clearinghouse closed the comment period on March 19, 2009. One agency responded, and it was an agency that had already sent an individual letter to the park. The EA was acknowledged to have complied with State Clearinghouse requirements on March 20, 2009.

The Errata, compiled as an attachment to the Abbotts Lagoon Area Dune Restoration Plan, consists of two sections below.

The first section (Section I) compiles all changes to the EA. These are for the purpose of clarification, amplification or further discussion, or corrections, and there are no substantive edits made to document contents. During public review, park staff also further reviewed the document and determined that that there were areas of the EA that required minor amendments or corrections, clarification, or more detailed discussion. Singularly and in combination, these amendments, corrections, clarifications, or additional discussion do not constitute a substantive change in the purpose of the project, the alternatives evaluated, the alternative selected for action, or the consequences of the alternatives, including the selected alternative. None of the comments from the public or agencies required any substantive changes in the document content.

To ease comparisons between the prepared EA and the Errata, the Errata are presented as complete pages from the EA with the added or deleted information either underlined or deleted through strikethrough. Where addition of information resulted in the need for additional pages, pages are numbered with the original page number and then the number of new pages (e.g., "176-1," "176-2," etc.).

The second section (Section II) focuses on detailed responses to comments in the seven (7) letters received. No responses provided any new information, raised unforeseen issues, nor addressed critical omissions that would require revising and reissuing the plan/EA for additional public review or that would change any determinations of environmental effects.

Section I

Soils and Sand Movement

Small-scale removal of *Ammophila* under the No Action alternative would loosen sand and restore some movement at the site. However, most of the *Ammophila* dominated foredune would remain in place, with continued moderate to major localized long-term adverse impacts on the natural movement of sand.

Grading to prepare staging areas under either action alternative would remove soils and use of access routes would increase compaction and possibly runoff or erosion. Heavy equipment may leak or spill fuel with some very localized contamination, although mitigation would keep these impacts to negligible or minor.

Soil at the site could experience short-term impacts from prescribed fire, herbicide use and excavation. Prescribed fire may have negligible to minor short-term effects to the surface layer of soil where *Ammophila* is burned and negligible to minor short-term benefits to soils by increasing nutrient levels. No impacts to the biological properties of soil from fire are expected. The impact of herbicide spraying to the biological and nutrient properties of soil are expected to be negligible to minor, may be beneficial or adverse, and would be short-term. Excavation in either Alternative B or C could have minor short-term impacts from eroding stockpiled supplies or redistributing sand. Recontouring would keep long-term impacts from excavation to negligible.

Restoring sand movement at the site would be a moderate to major localized benefit for soils, topography and the natural ecology of the area.

Water Resources

Relative long-term negligible to moderate benefits to water resources from the stabilization of soils at the site may have occurred and would continue if *Ammophila* is removed slowly as it would be in the No Action alternative.

Storing equipment, chemicals and fuel at the staging site in any of the alternatives would have no more than negligible short-term impacts to water resources because the area would be impermeable and bermed.

Fire breaks and mowed buffers would keep direct impacts to wetlands from becoming more than negligible or minor if Alternative B is selected. Ash from prescribed burns could add nutrients to soils and water, with possible negligible benefits. Impacts to water quality from herbicide spraying would be short-term and no more than minor; algae production may be stimulated if low levels of herbicide enter dune hollows or slacks. The exposure of stockpiled sand to wind and water erosion may increase sedimentation in the short-term, a negligible or minor localized effect of either action alternative to water resources related to excavation. In the long-term, remobilizing sand movement could fill in small wetlands completely and reduce the size or period the dune slack stays wet, a minor to moderate, localized adverse effect that would be long term. Burial of the site's unique fen-like sedge wetlands may be a minor to moderate adverse impact.

The proposed project may also be impacted by many of the direct and indirect effects of climate change, including sea level rise, increased wave action, and higher winds. However, reestablishing natural dune migration or movement would provide greater resiliency for this system to threats from climate change such as wave- and wind-induced erosion by allowing it to move in response to these pressures. This would ensure that this system remains viable in the future and would continue to provide valuable benefits for plants, animals, and humans through protection from extreme tides and storm surge.

Cultural Resources

No above ground cultural resources are present at the site, but buried resources may exist. Implementation of any of the alternatives would result in no greater than minor, localized adverse effects to cultural resources related to ground disturbance. However, both Alternatives B and C have greater potential to affect cultural resources than the No Action alternative because of excavation and the use of hand tools to dig up *Ammophila*.

Visitor Experience

Implementation of the No Action alternative would result in no greater than minor, short-term, localized adverse effects to the visitor experience related to the use of heavy equipment (noise, blowing sand, odors).

Under either action alternative, visitors to the project vicinity could experience minor to possibly moderate, short-term adverse impacts from visual intrusions associated with new staging and vehicular access areas. In addition, the exposure to noise from heavy equipment as well as their related odors and associated blowing sands have the potential to result in minor, short-term, adverse effects in Alternative B and possibly moderate adverse effects in Alternative C. Smoke, odors and possible ATV noise from prescribed burning activities in Alternative B and potential visitor restrictions during restoration activities in either action alternative may result in additional minor impacts to visitors. Minor, long-term benefits to the visitor experience in either action alternative are expected as a result of the restoration of this dune area to a more naturally functioning state and the provision of educational materials related to the restoration efforts.

Neighboring Land Use

Small-scale restoration efforts under the No Action alternative would have negligible to minor, adverse, localized effects on wilderness uses of adjacent park lands.

The implementation of Alternative B or C would result in negligible, adverse, short-term, localized impacts to ranching land uses adjacent to and overlapping the project site. Localized, short-term, negligible to minor adverse effects to those using wilderness lands to the west and north of the project site from smoke, odors, herbicide use and noise are also expected. In addition, in keeping with the guidelines from the Organic Crop Workbook published by NCAT, a 25-foot buffer between spraying of herbicide and adjacent areas certified as Organic Crop or Organic Livestock would be maintained. This buffer has been agreed to as being sufficient by both the ranching operators and the Marin County Department of Agriculture – Weights and Measures (John DiGregoria, 2009, *pers. comm.*).

Increased mobility of dunes could result in landward migration of dunes into current ranching leaseholds, particularly in response to increased wave- and wind-induced erosion as a result of climate change. As was described under the Affected Environment, all of these ranch lands and other park lands along the coast represent former dune sands that have moved inland in response to winds and wave action. Centuries of grassland establishment and subsequent organic matter deposition have transformed these once granular, relatively nutrient-poor, well-drained soils into fertile pastures. Overall, based on experiences from other restoration projects, impacts over the short-term would be expected to be negligible and minor over the long-term.

Health and Safety

Only negligible, adverse effects to worker health and safety are anticipated as a result of the use of heavy equipment as needed in the continuation of current restoration (the No Action alternative).

Access and staging of vehicles used for restoration activities would result in negligible, short-term adverse effects related to travel along primary and secondary access routes and the storage of potentially hazardous (e.g., fuel, herbicide) materials at staging areas in either action alternative. The use of heavy equipment to treat the steep foredune would require proper equipment, training and a safety plan to keep the chance of accidents and impacts to negligible or minor. Potential safety related impacts related to excavation are higher in Alternative C because this treatment technique is used more extensively than in Alternative B.

In Alternative B, potential for injury from exposure to fire, smoke or herbicides exists. A burn plan and closure of the area during prescribed fire would keep the risk of fire and smoke injuries to park staff and the public to minor, adverse, short-term and localized. Workers applying herbicide would be exposed to a dose of glyphosate that is 12 times lower than the EPA reference value where no adverse effects are expected. The most likely herbicide exposure scenario for the public, given that the area would be closed for 48 hours following spraying, is contact with sprayed vegetation which would expose a visitor to a dose hundreds to thousands of times lower than the reference dose. These are negligible impacts.

- would not be completed unless additional line item budget funds from the National Park Service were allocated for them, so no or only negligible impact to the park's operating budget is expected. Therefore this issue is not analyzed further in the document.
- Impacts to wilderness areas- the site is not in a designated or proposed wilderness area. Impacts to neighboring wilderness from noise and human activities are part of the *Neighboring Land Use* analysis.
- ~~Impacts from climate change- The U.S. Geological Survey (USGS) has identified Point Reyes National Seashore as particularly at risk among American shorelines for impacts related to global sea level increases (http://coastalmap.marine.usgs.gov/GISdata/nps_cvi/pore/pore_shore.zip), and especially beaches on the west side of the park including the project area. Restoring the project area so that it is vegetated with native species would help in minimizing the impact of global climate change and rising sea levels on dune natural resources by creating reardune habitat for these species; thereby making the overall park population more resilient to unstable climate conditions.~~
- Impacts to Air Quality- The use of cars and trucks to transport crews, as well as heavy equipment on site will result in the emission of criteria pollutants. Prescribed burning would emit smoke, which is a combination of pollutants, including large and small particulates, volatile organic compounds, carbon monoxide and nitrogen oxides. However, the degree of impact for all air quality emissions would be negligible and short-term. Negligible impacts are defined by the NPS as fewer than 50 tons per year of any pollutant emitted. Both alternatives would include the use of excavators. In Alternative B, driving each excavator (the analysis assumes up to two excavators or other pieces of heavy equipment working simultaneously) one hour per day to and from the refueling location would generate 0.06 tons hydrocarbons (HC), 0.3 tons carbon monoxide (CO), 0.2 tons nitrogen oxides (NOx) and 0.04 tons particulates over the life of the project. In this same alternative, excavators removing *Ammophila* (used for about 65 days) may generate up to 0.5 tons of hydrocarbons, 2.3 tons of carbon monoxide, 1.6 tons of NOx and 0.3 tons of particulates over the life of the project. This would increase in Alternative C as excavators would be used for an estimated 160 days. In Alternative C, emissions from heavy equipment would be 0.2 tons hydrocarbons, 5.6 tons CO, 0.7 tons particulates and 3.84 tons NOx over the life of the project. The emissions from refueling would also increase in Alternative C and are estimated to be 0.15 tons HC, 0.7 tons CO, 0.5 tons NOx and 0.09 tons particulates over the life of the project.

Smoke from prescribed burning in Alternative B would have an additional impact from particulates and other volatilized substances. Although emissions from burning were not modeled for this project, using those for the park's Fire Management Plan (NPS 2004) indicate the following emissions would occur for 90 acres of prescribed burning: 7 tons of particulates, 8.2 tons of carbon monoxide, one ton of hydrocarbons, and 0.23 tons of NOx. These numbers assume the burning of grasslands and coastal scrub vegetation similar to that on site. The total emissions of Alternative B would be 1.56 tons hydrocarbons, 10.8 tons carbon monoxide, 2.03 tons NOx, and 7.34 tons particulates. Total emissions from Alternative C are: 0.35 tons hydrocarbons, 6.3 tons CO, 0.79 tons particulates and 4.34 tons NOx. Each of these is well below the definition of negligible impacts for air emissions and so air quality is not discussed further in this environmental assessment.

outlined in the prevention plan initiated. Spill response kits would be kept with the heavy equipment and stored in the on-site staging areas. Kits would likely contain spill berms, hazardous materials drums, drip pans, and absorbent materials.

Measures to Protect Cultural Resources

A cultural resource monitoring plan would be prepared to ensure that ground-disturbing activities within the areas of two identified buried soil levels result in no adverse effects to buried resources. Archaeological monitoring of paleosols or buried ground surfaces would be periodically conducted during dune restoration activities by a qualified cultural resource specialist. The monitoring program would include oversight of project schedules and excavation depths to insure that important opportunities for archaeological discovery are realized, and that potentially buried archaeological deposits are recognized in the course of active excavation and restoration. Archaeological monitoring of paleosols or buried ground surfaces would be conducted during dune restoration activities.

In areas where ground disturbance related to equipment/vehicular access is expected, staging and parking, monitoring by a qualified cultural resources specialist would be routinely conducted during site preparation and, in the case of access routes, throughout the life of the project.

Heavy equipment operators would undergo training for the identification of cultural resources that may be encountered during excavation, as well as what to do if they are encountered.

If previously unidentified cultural resources are encountered during restoration activities, the NPS would ensure that appropriate actions (e.g., cease work, evaluation) for Section 106 (NHPA) compliance are taken.

Measures to Protect Neighboring Land Use

Restoration of natural dune process could result in migration of dunes inland into existing ranchlands. Monitoring stations would be established throughout the Project Area and on the inland perimeter to assess dune movement and determine whether encroachment into adjacent ranchlands occurs. Information from this monitoring would be used during the five-year reappraisal process to determine the extent of grazable land. Overall, based on experiences from other restoration projects, impacts over the short-term would be expected to be negligible and minor over the long-term.

Both the AT&T and G Ranch operations are either certified organic land or livestock. In keeping with the guidelines from the Organic Crop Workbook published by NCAT, a 25-foot buffer between spraying of herbicide and adjacent areas certified as Organic Crop or Organic Livestock would be maintained. This buffer has been agreed to as being sufficient by both the ranching operators and the Marin County Department of Agriculture – Weights and Measures (John DiGregoria, 2009, *pers. comm.*).

Measures to Protect Recreational Use

Construction dates/times, planned closures of portions of the project site and adjacent areas, and suggestions for alternative recreational opportunities would be provided to visitors via docents, rangers, park website, Visitor Center, parking lots/trailheads, etc., and posted at the project site in advance.

To minimize the effects of treatment-related noise on the natural quiet of the project area, heavy equipment would be required to have sound-control devices at least as effective as those originally provided by the manufacturer, and no equipment would be operated with an unmuffled exhaust. Signs in the project vicinity and on the park website would provide information on the NPS contact person for any noise concerns. This staff person would

record and monitor construction-related noise complaints to determine if adverse effects can be mitigated further.

Measures to Protect Health and Safety

All tasks associated with project implementation would be conducted with the highest priority being the health and safety of staff, contractors and the public. Where appropriate for specific project tasks, adequate training and/or certifications would be required for staff and/or contractors.

Herbicides would be used in accordance with a Pesticide Use Proposal approved by the Pacific West Regional Integrated Pest Management Coordinator. Approvals require tracking of herbicide quantities and locations of applications. All herbicide applications would be conducted by state-certified applicators. All herbicide application would be in compliance with manufactures' labels and would occur only under prescribed weather conditions. Calibrated backpack sprayers with adjustable single-wand nozzles would be used to avoid overspraying onto non-target vegetation and open sand areas. Where appropriate, the

possible using herbicide and/or hand removal only. The initial removal work would be followed by up to five (possibly more) maintenance treatments to remove resprouting exotic vegetation. Long-term maintenance is expected to require minimal effort and would likely be necessary only along the perimeter of the project, adjacent to untreated stands of exotic vegetation.

Treatment of the reardunes would consist of a single prescribed burn followed by herbicide spraying of regrowth over 93 acres. The burn would be started using drip torch fuel distributed by hand crews or by people on ATVs. The purpose of the burn is to remove above ground biomass (beachgrass thatch) and encourage vigorous new growth of beachgrass. New growth would provide a sufficient leaf surface area to absorb herbicide, and ultimately would reduce the amount of herbicide necessary for treatment.

As an environmental mitigation and protection measure for the threatened Western snowy plover, both action alternatives would treat reardunes before the foredunes. This is to keep plover chicks from entering the reardunes through naturally occurring blowouts in the foredunes, which could occur if the foredunes were restored first.

Beach Grass Removal

The herbicide glyphosate (part of the commercial formulation known as Roundup®) is most likely to the product that would be used to kill *Ammophila* when it begins to grow in the spring. Glyphosate would be applied at up to 7-8% concentration using backpack sprayers or through direct contact by wicking, the latter a technique where herbicide is applied via a wand with a tip wetted by glyphosate. The herbicide would flow to the wand from a backpack and would not be subject to drift from wind. Backpack sprayers could emit some overspray during higher wind conditions, but this would be minimized through the use of calibrated nozzles; in addition, glyphosate is a minimally volatile chemical. To further minimize the chance of inadvertent contamination by drift, it would be applied only when wind speed is below 10 miles per hour and shields would be employed if needed. Broadcast applications would not be used anywhere within the project area.

Glyphosate is made by a number of different manufacturers; for example there are currently 35 commercial formulations of glyphosate registered for forestry applications (USDA Forest Service 2003). The exact product the park would use is not yet known, but is likely to be Rodeo® or some similar formulation with the lowest possible toxicity that is still effective. Roundup® is another familiar formulation of glyphosate which contains a toxic surfactant (chemical to help in the absorption of glyphosate); Roundup® would not be the formulation chosen by the park ~~because of this surfactant~~. Choice of glyphosate is based on the best available information on the most effective and least environmentally damaging approaches at this time. However, should information become available from other resource managers on more effective approaches, a different herbicide or mix of herbicides may be employed. A herbicide formulation that does not include any surfactant that would potentially be damaging to water or aquatic organisms will be selected.

Herbicide use on lands managed by the National Park Service requires initiation and approval of a Pesticide Use Proposal. Approvals are provided by the Pacific West Regional Integrated Pest Management Coordinator. Approvals require tracking of quantities and areas where pesticides are used. All herbicide application would be in compliance with manufacture's labels and would occur only under specific weather conditions.

The results of treatment are discussed in the Environmental Consequences section of this EA. However, in summary, it is anticipated that newly restored open sand habitats would

return to their pre-disturbance condition. Foredune sand would be unrestrained by plant biomass and allowed to migrate and form the perpendicular dune ridge typically found in undisturbed dune ecosystems. This perpendicular orientation would form migration corridors providing access between foredune and reardune areas, increasing amount/variety of wildlife habitat available.

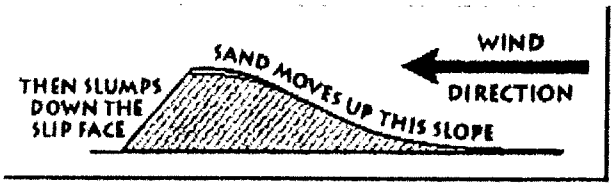
	No Action	Alternative B	Alternative C
Water Resources			
Dune slacks and other wetlands	Negligible to moderate long-term benefits from artificially stabilized soils.	Negligible or minor adverse and beneficial short-term impacts from prescribed burning; herbicide use; exposure of stockpiled sand may have negligible adverse impacts on wetlands. Long-term minor to moderate adverse impacts from remobilized sand movement.	Minor adverse short-term impacts from exposure of stockpiled sand to wind and water erosion; Long-term minor to moderate adverse impact from remobilized sand movement.
Groundwater	No impact.	Negligible short-term adverse impacts possible from spills at staging site.	Same as Alternative B.
Sea Level Rise and Wave-Induced Erosion	Potential minor to moderate long-term adverse impacts anticipated from inability of Ammophila-stabilized dunes to migrate in response to pressure from sea level rise and wave- and wind-induced erosion. Reduced dune system would provide less of a buffer for adjacent lands to storm surge.	Potential minor to moderate long-term beneficial impacts anticipated with ability of restored dunes to migrate in response to pressure from sea level rise and wave- and wind-induced erosion. Restored dune system would provide more buffer for adjacent lands to storm surge.	Same as Alternative B.
Cultural Resources			
Archeological resources	Minor, localized effects from ground disturbance possible.	Preparation and use of staging areas may uncover resources; mitigation will keep impacts from this source to no more than minor; Use of excavators and hand tools to dig up *Ammophila* could have minor adverse effects assuming mitigation in place.	Preparation and use of staging areas may uncover resources; mitigation will keep impacts to from this source no more than minor; Minor adverse effects from excavation, digging assuming mitigation in place.
NHRP 106 finding	No adverse effect.	No adverse effect.	No adverse effect.

	No Action	Alternative B	Alternative C
Visitor Experience			
	Negligible to minor localized short-term adverse effects from noise, dust, odors from excavation during small-scale treatment.	Minor to moderate short-term localized adverse effect from visual intrusion of staging areas; minor, localized adverse effect possible from blowing sand, odors, and noise from excavators; negligible to minor short-term adverse effect from smoke and area-wide impact from noise (all-terrain vehicle [ATV]) during prescribed burn; minor short-term adverse impact from closures during and following herbicide application; Minor long-term benefit from returning natural conditions at site.	Minor to moderate short-term localized adverse effect from visual intrusion of staging areas; Minor to moderate short-term adverse effects from continuous work by excavators and associated noise, odors and blowing sand; Minor long-term benefit from returning natural conditions at site.
Neighboring Land Use			
Adjacent Wilderness	Small-scale treatment may have negligible to minor short-term adverse effects on wilderness character.	Smoke from prescribed burn, herbicide use and noise, visual appearance and odors from excavators would have negligible to minor adverse short-term impacts on character of adjacent wilderness.	Visual appearance, noise and odors from excavators would have negligible to moderate adverse short-term impacts on character of adjacent wilderness.
Adjacent ranching	No impact	Establishment of a 25-foot buffer between use of herbicide and certified organic pastures and herds would reduce any potential adverse impacts to negligible short-term. Potential movement of sand dunes once beachgrass is removed would potentially cause migration inland, but intensity of impacts would be reduced through monitoring and coordination with ranchers to minor adverse over the long-term.	Generally same as Alternative B. Potential for adverse impact from herbicide use would be even more negligible because the scale of herbicide used would be substantially reduced.

inputs of detritus and nitrogen fixing bacteria, as one study at Point Reyes has indicated (Pickart and Sawyer 1998). Dune slack soils have higher levels of nitrogen than beach sands. Phosphorus level in dune plants is enhanced by a symbiotic relationship with arbuscular mycorrhizal (AM) fungi near the roots. AM fungi have also been shown to be beneficial by promoting sand aggradation and improving nitrogen fixation in legumes (ibid.).

Natural dune morphology in California coastal areas includes foredunes, ridges and hollows in the reardunes and a deflation plain. The primary foredune is a ridge of sand that forms parallel with the coast above the mean high tide line. It is buffeted by onshore winds, and so is vegetated by plants that are tolerant of sand burial. Under normal circumstances (e.g., without invasion by nonnative species), the foredune is sparsely vegetated by native dune grass allowing periodic blowouts of sand. The wind pushes sand inland through the blowouts forming crests and valleys or U-shaped dunes perpendicular to the coast.

These longitudinal ridges and valleys behind the foredune are also sparsely vegetated, and move slowly inland by the forces of wind and slumping along the lee face as slopes exceed the angle of repose. The spaces between the ridges may be seasonally flooded by a rising water table, forming dune slacks or dune hollows. Wetland vegetation grows and stabilizes the dune hollows. The inland margins of dune hollows migrate southeast behind the trailing edge of moving sand. The ridges and troughs or series of U-shaped dunes are also referred to as the reardunes (or as the foredune "complex" in Pickart and Sawyer 1998).



Parabolic dunes are larger influxes of sand and sand movement that periodically occur. These can merge into a large sand plain or sand sheet, which can be nearly devoid of vegetation. As the sheet moves inland, a large "deflation plain" is left behind. Where sand is blown sufficiently to reveal the groundwater table in a deflation plain, wetlands form either seasonally or permanently.

Inland of these active dunes are remnants of former dunes, evident in the sandy characteristics of the soils that now underlie vast managed grassland, coastal prairie, or coastal scrub lands along the coast. Many of the soils in these areas adjacent to the dunes have been mapped as Sirdrak Sand. Sirdrak Sand represents deposits of latest Pleistocene to Holocene eolian dune sand (<30,000 y.o, Knudsen et al. 2000). The soils derived from wind-deposited beach sand and uplifted beach deposits originating from large volumes of fluvially derived sediment being deposited after weathering of adjacent terrestrial geologic formations such as the Franciscan Formation (Gogan et al. 1989, Atwater et al. 1977 *in* Knudsen et al. 2000). Centuries of grassland establishment has led to establishment of a mollisol over most of these former dune sands. Mollisols develop through significant accumulation of humus or organic matter in the surface horizon, or uppermost layer, of soils: this organic matter always almost derives from grass vegetation. Mollisols have deep, high organic matter, nutrient-enriched surface soil (A horizon), typically between 60-80 cm thick, that is known as a mollic epipedon.

European beachgrass has altered the natural morphology of dunes at the study site. The details of how it has been altered are discussed in the impacts of the No Action alternative, which examines the effects of continuing to leave dunes untreated. In brief, the primary foredune topography has changed to a steep continuous slope without blowouts, and the orientation of the ridges and troughs in the reardunes are parallel rather than perpendicular to the coast. This has prevented large-scale sand movement or fresh supplies of sand to the area inland of the primary foredune. In the study area and in many shorelines of northern

California and Oregon, foredunes are stabilized and steeper because they are colonized and stabilized by European beachgrass.

Water Resources

In addition to the marine environment and dune slacks discussed above under *Vegetation*, the primary water resource at the study site is the lower lobe of Abbotts Lagoon. The northern border of the study site abuts the far southwest corner of this lobe of the lagoon (see figure 10). The lower lagoon is brackish, and is periodically open to the Pacific Ocean for short periods of time during high flow in the winter or early spring (Saiki and Martin 2001). As spring progresses into the dry summer and fall, water levels in the lagoon drop and beaches or other features on the shores of the lagoon submerged during the winter are exposed. Between winter and late summer, water levels can drop by as much as 4-6 meters and flow into the lower lagoon is either very low or stopped altogether. Low water conditions persist into the fall.

Most water quality variables are similar across the lagoon. Water temperature averages about 15-16° C, dissolved oxygen concentrations average 7.0-8.8 mg/L, pH averages 6.7-7.6 and turbidity averages 4.4 to 10.7 NTUs (nephelometric units) (Saiki and Martin 2001). However, salinity, water depth and total ammonia levels do vary from upper to lower lagoon. Salinity is much higher in the lower lagoon, in the neighborhood of 0.47 to 0.5%, where brackish is 0.05 to 3%, saline is 3-5% and fresh water is less than 0.05% salinity. In the upper and middle lagoons, it is 0.02 to 0.05%. Total ammonia is highest in the upper lagoon, but decreases to 0.06 to 0.09 mg/L in the lower lagoon. Water depth is greater in the lower lagoon, averaging 4-6 meters. A mixture of sand and silt predominates in the bottom substrates.

Dune hollows or dune slacks are additional water resources at the site. As noted in other sections, dune hollows form at the trailing edge of parabolic dunes as the capillary fringe of the groundwater table is exposed, and are primarily present on the site in the deflation (i.e., formed by active sand erosion) plain behind the primary foredune (Baye 2005). Dune slacks at the treatment site are shown on figure 8. The depth to groundwater and the movement of dunes to expose it varies seasonally and between years; however vegetation established in the wet periods can persist to a more limited extent in drier times to stabilize sand. These perennial wetlands tend to be long and narrow and aligned with the site's northwest winds. Dunes can also obstruct seasonal drainages and impound hillslope runoff in gulches and ravines forming ponds or wetlands.

The effect of European beachgrass at the site has very likely been to capture most of the fresh sand deposited in the primary foredune, amplifying the development of a wide dune deflation zone downwind with extensive sand-starved dune slacks. At Tomales dunes north of the site, a similar dune slack forms a continuous plain with little topographic relief, containing a mixture of native marsh and nonnative pasture grasses. In some years, ponds can be perennial and up to 1.5 meters deep when flooded, drawing down to groundwater seasonally in late summer (Baye and Wright 2004).

Water quality at dune slack sites would be similar or identical to groundwater quality. Although it has not been measured at the site, groundwater quality would likely be similar to that described above for upper Abbotts Lagoon for salinity and pH, with lower turbidity and total ammonium levels from the filtering action of the sandy subsoils and bedrock.

Sea Level Rise and Climate Change-Related Increases in Wave-Induced Erosion and Storm Surge Protection

As with many ecosystems, dunes often undergo periods of cyclic stabilization and rejuvenation (Pickart and Sawyer 1998). Rejuvenation events are the result of changes in relative sea level, which, in turn, have been attributed, at least in the past, to tectonic activity, including tsunamis (Vick 1988, Pacific Watershed Associates 1991, Clarke and Carver 1992, Komar and Shih 1993 in Pickart and Sawyer 1998). Both uplift and subsidence can trigger reactivation of dunes, with the former potentially building or expanding dunes through increased sediment supply, while the latter can destroy dunes through increased wave action or limit the expansion of new dunes (Pickart and Sawyer 1998). During and in between these major dune-forming and dune-destruction periods, dune morphology continues to be shaped by other factors, including wave action and offshore winds. Offshore winds create "blowouts" or northwest-southeast trending swales or low areas that are parallel with the prevailing northwesterly winds. When dunes are sparsely vegetated, the strength of these winds is sufficient to mobilize sands and cause movement or creep of dunes inland over time. New foredunes and associated parabolic dunes are then created from new sediments supplied by the ocean. These complex dune

systems play a valuable function in protecting inland areas from the effects of storm surge, as well as filtering terrestrially derived groundwater before it flows into the sea.

In addition to tectonic activity, another set of factors that can stabilize or rejuvenate dune systems are hydrologic effects of climate change. Climate change can affect dune systems through a myriad of direct and indirect effects, including changes in temperature, wind, precipitation, freshwater hydrology, sediment supply and transport, sea level rise, and ocean circulation. With climate change study being a relatively young science, the exact magnitude and extent- and even the direction -- of these changes on the northern California coast is still a matter of active debate. Based on records from the past century, sea level is rising, and sea level rise increases wave action, which can destabilize dune systems.

NOAA reports that, based on review of historic (1854-1999) water level gauge data, sea level has risen at a rate of 0.00328 to 0.0079 feet/year over the last century and that sea levels have risen 0.007 feet/year in San Francisco since 1906 (NOAA 2001) in KHE 2006a). Based on 25 years of Point Reyes water level records, NOAA predicts a local sea level rise rate of 0.0082 feet/year in this region (NOAA 2001 in KHE 2006a). Based on recent satellite altimetry studies, Cazenave and Narem (2004) report a "very accurate" sea level rise rate of 0.0092 ± 0.0013 feet/year for the 1993-2003 decade. This rate is notably higher than what NOAA's rate of change based on measured changes in tide gauges over the preceding half century (KHE 2006a). In 2005, the USGS completed a relative coastal vulnerability study that depicted most of Tomales Bay as having low to moderate vulnerability to sea level rise (Pendleton et al. 2005).

The Intergovernmental Panel on Climate Change (IPCC) has developed estimates of sea level rise based on a number of emissions scenarios, with perhaps the most widely accepted rise being 0.5 m (1.65 feet) by 2100. Most recently, researchers from University of Arizona, the National Center of Atmospheric Research, and other institutions suggest that accelerated melting of the Arctic and Antarctic ice caps and Greenland glaciers could raise sea level by as much as 3 feet by the end of this century and 13 to 20 feet in coming centuries (Overpeck et al. 2006; Velicogna and Wahr 2006). A recent study suggests that some of these even numbers could be underestimates due to the fact these models – including the IPCC ones -- did not incorporate key forces such as gravity and changes in the Earth rotation, leading to potentially another 4- to 5 feet in sea level rise if the West Antarctic Ice Sheet collapses (Clark et al. 2009).

Alternatively, climate change may increase precipitation and associated run-off and thereby increase the supply of sediment from the surrounding watersheds that may eventually be transported to the ocean for deposition in beach areas. On average, recent projections show little change in total annual precipitation in California or in the Mediterranean pattern of rainfall, with most falling during winter from north Pacific storms (California Climate Change Center 2006). However, one climate model does predict slightly wetter winters, while another predicts slightly drier winters with a 10 to 20 percent decrease in precipitation (California Climate Change Center 2006).

Climate change may also be associated with a change in wind patterns and strength. A recent study showed that land temperatures are increasing at a faster rate than ocean temperatures, and this thermal gradient is already resulting in increased winds (Snyder 2008). The University of California, Santa Cruz team ran several regional climate change models based on modern climate (1968 to 2000) and future climate (2038 to 2070) using input from the Intergovernmental Panel on Climate Change (IPCC AR4) for "high-growth" emissions scenarios. Results showed an increase in wind speed of up to 2 meters/second, which is a large change relative to the current average wind speed of 5 meters/second (Snyder 2008). Ironically, while climate change is predicted in general to increase ambient

air temperature by 1.5 degrees Centigrade (2.7 degrees Fahrenheit) to 4.3 degrees Centigrade (8.2 degrees Fahrenheit) by the end of this century (Cayan et al. 2008), the increase in temperature gradient along the coast may actually decrease temperatures along the coast (Snyder 2008).

This trend would seemingly favor continuation of the fog "belt" that typically cloaks the coast during the summer and days when temperatures soar in inland areas. Fog in northern California is strongly related to the phase of the Pacific Decadal Oscillation (PDO), as well as interannual variability in coastal sea surface temperature and sea level pressure over the interior western United States (J. Johnstone, UC Berkeley, unpub. data). The frequency of fog closely approximates the temperature differential between coastal and inland weather stations (J. Johnstone, UC Berkeley, unpub. data). Interestingly, while predicted changes discussed above would suggest a potential increase in fog, monitoring shows that the frequency of fog has varied substantially over the last 100 years, but, in general, the range of frequencies has declined from approximately 48 to 64 percent around 1900 to typically between 31 and 48 percent from 1980 to 2000 (J. Johnstone, UC Berkeley, unpub. data).

These hydrologic and physical factors will affect not only dune morphology and the temporal and spatial patterns in dune forming and dune destruction, but the plant and animal communities considered characteristic of these systems. Ultimately, the existing condition of dune systems – and actions taken to change those conditions – may influence the future viability of these systems and their resilience to sea level rise and other hydrologically related climate change effects. It may also affect how well these systems continue to play vital functions such as storm surge protection and filtration of terrestrially derived groundwater flowing into the sea.

Neighboring Land Use

Adjacent to the site are lands zoned as wilderness and lands used for cattle ranching. Figures 12 and 13 show that the sites northern boundary comes very close to the wilderness boundary; however the study site was left out of wilderness designation, at least in part because ranches and former private property (owned by AT&T) occupied land in the vicinity. Now the Evans (former AT&T) and Lunny permitted ranching operations do overlap the eastern portion of the site. The Evans operation on ATT Ranch supports 35 Animal Units for a cow/calf cattle operation, which are grazed on pasture that has been certified by the Marin County Department of Agriculture - Weights and Measures as organic pasture. G Ranch, operated by the Lunny family, is authorized to stock 90 animal units for a cow/calf cattle operation with certified organic animals on certified pasture. Other than corrals for working the animals, there are no physical ranching operations on ATT Ranch, except for watering troughs and fencing. As noted in the Alternatives description, part of the former AT&T land would be used for access and staging. Most of the treatment area of the site is fenced so that cattle cannot access it; however, ranching vehicles do use the roads leading to the staging area.

Health and Safety

Currently, there are no health and safety concerns at the project site. However, small-scale restoration projects in the vicinity of Abbotts Lagoon (to the north of the project site) have involved the use of heavy equipment—a potential safety issues for workers and visitors. The use of heavy equipment, prescribed fire and herbicides under the action alternatives all have the potential to result in health and safety effects, primarily to workers.

believed to be a perched groundwater table with subsurface flows (Baye 2008) underlying the dune hollows and dune slacks at the site. This has been a relative positive impact for wetlands at the site, as it has preserved and extended the season they are wet and allowed them to expand.

Ammophila may have also stabilized sand that would otherwise blow into and partially fill the shoreline of Abbotts Lagoon. Because it is heavy, sand would quickly fall to the bottom of the lagoon and would have no water quality impacts. However, over time, sand may fill in part of the lagoon and decrease its size. Again, *Ammophila* may have played a role in maintaining the size of the lower lobe of the lagoon, a relative benefit for water resources at the site.

The degree of benefit is unknown, but may be negligible to moderate and long-term.

Sea Level Rise, Wave-Induced Erosion, and Surge Protection

Looking towards the future, this dune system is likely to be affected by hydrologic effects related to climate change, with sea level rise being the predominant issue. With sea level rise, wave action will increase, which may erode portions of the dunes, although Ammophila may act to stabilize the dunes over the short-term. Over the long-term, increasing sea levels could essentially "drown" out current foreshore and foredune edges, with the extent of loss dependent on the magnitude of sea level rise. As discussed earlier, moderate IGPCC scenarios point to approximately a 0.5 m (~1.65 feet) increase in sea level by 2100, but other models suggest more drastic increases of up to 3 feet over the next century (Overpeck et al. 2006, Velicogna and Wahr 2006). Climate change may increase precipitation and associated run-off and thereby increase the supply of sediment available for deposition in beach areas, but this increase in sediment delivery may only further exacerbate the unnaturally high elevations in the foredunes. If, as some models predict, coastal winds increase as a result of climate change, then these higher velocity winds may result in some erosion of more sparsely vegetated portions of the dunes, potentially those areas that support listed plant species and critical dune mat wildlife habitat.

Over the short-term, the over-stabilized dune system would continue to provide some buffer against storm surge and extreme tides to adjacent inland areas, but over the long-term, these benefits would be reduced by loss of dunes from sea level rise and wave energy and wind-induced erosion. The dunes would not be able to migrate inland to counter the rising sea level and erosional pressures. Depending on the number of small projects conducted in the project area in the future under No Action, minor to moderate adverse effects would be expected to important dune hydrologic functions such as storm surge protection of adjacent inland areas and filtration of terrestrially derived groundwater before it flows into the ocean.

Cumulative Impacts

Cumulative impacts to wetlands at the site include cattle grazing nutrient inputs and alterations in the species and structure of wetland vegetation. By grazing vegetation at wetlands, cattle can keep wetlands from becoming closed and filled. Grazing operations upstream of Abbotts Lagoon contribute fecal coliform and are considered primarily responsible for coliform counts than exceed standards in tributaries of the Abbotts Lagoon watershed. Fencing cattle from all dune locations is called for in the park's General Management Plan, which would prevent adverse impacts from grazing.

Overall, minor adverse effects would be expected over the long-term to hydrologic functions provided by the Seashore's 1,700-acre dune system due to possible degradation or even loss of some or all of the dunes within the 300-acre project area.

Conclusions

Relative long-term negligible to moderate benefits to water resources from the stabilization of soils at the site may have occurred and would continue if *Ammophila* is not removed. Minor to moderate adverse impacts to important dune hydrologic functions such as storm surge protection and filtration of groundwater could occur with climate change due to the inability of the over-stabilized, Ammophila-dominated dune system to migrate in response to sea level rise and wave- and wind-induced erosion. Cumulative impacts include nutrient and pathogen inputs from cattle grazing in the watershed and locally, as well as possible changes in wetland structure and vegetation.

No impairment to park water resources from implementing Alternative A would occur.

Impact of Alternative B

Analysis

Staging and Access

Staging or access routes would be sited to avoid wet areas at the study area, and no or only negligible indirect impacts to water resources from increased compaction and runoff or erosion from either access routes or the staging area itself would occur.

The use of heavy equipment on the project site would require the development of a plan and strategy to address the prevention and containment of leaks or accidental spills of hazardous substances, particularly hydraulic fluid, gasoline, and oil. Spill prevention measures would include ensuring that equipment is parked or staged on top of an impermeable surface. This may include the use of tarps or pans while the equipment is parked on the project site, or paved parking areas in an off-site staging area. Staging or parking areas would be located away from water bodies or other sensitive areas. Daily inspections of machinery would be required to detect leaks and identify preventive maintenance needs.

In the event of a spill or leak, each piece of equipment would have the proper containment equipment readily at hand, and the operator would be trained in the proper protocol and use. NPS staff and/or biological monitors would be notified and the disposal procedures outlined in the prevention plan initiated. Spill response kits would be kept with the heavy

initial concentrations of 0.02 to 0.15 mg/L dissipated to 0.001 mg/L (a 95% to over 99% reduction) by day 12 (Goldsborough and Beck 1989 as cited in USDA Forest Service 2003).

While direct spraying of wetlands would not occur, there may be some contamination through inadvertent drift. At 100 m from the source (boom ground sprayer), the amount of glyphosate remaining in drift is about 0.06% of that originally sprayed. Assuming 1-2 lb a.e./acre is sprayed, this means about 0.14 ounces on average, or 4 grams would remain in the spray at 100 m. Although spraying may be closer than 100 m, modeling assumed a low boom ground sprayer rather than a backpack sprayer, and only evaluated concentrations at this distance. Concentrations in drift may therefore be slightly greater or lesser than those reported in this analysis. Assuming the volume of water in a dune hollow is similar to the small pond modeled by USFS (less than 50 cubic meters), concentrations from drift could initially reach 0.08 mg/L. Acute concentrations from spraying *Ammophila* followed by heavy rainfall could be about 10 times this amount. In either case, glyphosate would rapidly dissipate and would not be expected at these concentrations to have any impact on aquatic animals. The reference dose for human consumption, which is 1/100 the amount where no adverse effects in any study have been observed, is 2 mg/kg/day. A human or other mammal weighing 70 kg would need to drink 175 liters of contaminated water from the wetlands the day the area was sprayed and rainfall occurred and absorb 100% of the glyphosate in the water to reach this level. As noted in the discussion of vegetation, low amounts of glyphosate could stimulate algae production, which ultimately could mean reductions in oxygen and fish kills. Overall, impacts to water resources from herbicide spraying are not expected to be greater than minor in intensity, and would be short-term in duration.

As explained in the analysis of soils and sand movement, excavation could increase erosion of stockpiled clean sand either from wind or water. If sand is washed into nearby wetlands, it may affect turbidity for a short period of time and over a longer time, could fill in a portion of the wet area. However, sand would only be stockpiled for a short period of time in any one area of the site, and impacts to water resources from erosion are not expected to be more than negligible or minor and short term.

In the long-term, dunes across the site would be free of *Ammophila* and sand movement would increase. Although this is a more natural state, the pace of removal would be quick and dunes across the site would be left unvegetated for a time until native species can re-colonize the site. During this time, sand movement could reduce the size of Abbotts Lagoon and dune slacks and hollows at the site. Burial of the site's unique fen-like sedge wetlands would be a particularly adverse impact, as this combination of vegetation, soils and topography are very rare and perhaps even unique in central coastal California (Baye 2008). The long-term impact from treating *Ammophila* to water resources is likely to be minor to moderate, adverse and localized.

Sea Level Rise, Wave-Induced Erosion, and Surge Protection

The extent and magnitude of many of the hydrologic and morphological changes will ultimately be dictated to some degree by the diverse and far-reaching effects of climate change. With sea level rise, wave action will increase, which may erode portions of the dunes, and increasing sea levels could essentially "drown" out current foreshore and foredune edges, with the extent of loss dependent on the magnitude of sea level rise. As has been discussed, moderate IGPCC scenarios point to approximately a 0.5 m (~1.65 feet) increase in sea level by 2100, but other models suggest more drastic increases of up to 3 feet over the next century (Overpeck et al. 2006, Velicogna and Wahr 2006). However, with removal of Ammophila, the dunes should be able to migrate or move inland in response to these increased erosional pressures. Through increased precipitation and

associated run-off, the supply of sediment available for deposition in beach areas may increase and provide more material for formation of new dunes inland. If, as some models predict, coastal winds increase as a result of climate change, then these higher velocity winds may result in some erosion of more sparsely vegetated portions of the dunes, potentially those areas that support listed plant species and critical dune mat wildlife habitat. These winds may also cause more active dune movement, increasing the number of blowouts and movements of parabolic and transverse dune areas. Through improved mobility from removal of Ammophila, the long-term viability of this dune system will be enhanced, and the restored dunes should continue to provide some buffer against storm surge and extreme tides even in the face of increased sea level, wave energy, and wind-induced erosion, as well as filtration of terrestrially derived groundwater flowing out to the ocean. This will result in minor to moderate beneficial effects for the Project Area and adjacent lands.

As has been described, most of the removal efforts would be concentrated in the first 3 years of the project, with retreatment effort by herbicide or by hand removal decreasing over time. Some monitoring and small-scale maintenance removal is likely to be needed for at least 15- to 20 years after five (5) years of consistent maintenance. Climate change effects may not necessarily impact construction, but could impact maintenance. Should winds increase in strength or frequency of winds over 10 mph, the number of days in which spraying can be conducted may be reduced substantially, thereby requiring more hand removal efforts. Spraying would not be conducted within 24 hours of likely or actual precipitation, so any increase in the frequency of precipitation could limit opportunities for chemical retreatment. Increases in the occurrence of heavy fog conditions, which also constrains the use of herbicides, could also affect maintenance options. Climate change could have an unknown effect on phenology of various species to be protected. Climate change effects are more likely to have an effect in later years (at least five years post-construction), when the scale of maintenance needs has declined so, therefore, differences between Alternative B and Alternative C with regards to how these alternatives affect response or resilience of the project or these systems to hydrologic effects of climate change is negligible.

Cumulative Impacts

Cumulative impacts to wetlands at the site include cattle grazing nutrient inputs and alterations in the species and structure of wetland vegetation as described above for Alternative A. Cattle grazing may have a beneficial cumulative impact on maintaining open water wetlands by consuming wetland vegetation.

Overall, the proposed project would be expected to have minor beneficial effects on hydrologic functions provided by the 1,700-acre of dunes in the Seashore such as storm surge protection and groundwater filtration. In addition, this alternative will have minor beneficial cumulative effects by increasing resiliency of at least 300 acres of the Seashore's 1,700-acre dune system.

Conclusions

Storing equipment, chemicals and fuel at the staging site would have no more than negligible short-term impacts to water resources because the area would be impermeable and bermed. Minor to moderate beneficial effects to important dune hydrologic functions such as storm surge protection and filtration of groundwater could result from restoration of the dunes by enabling them to migrate in response to sea level rise and wave- and wind-induced erosion and thereby enhancing long-term system viability. This alternative will have

Fire breaks and mowed buffers would keep direct impacts to wetlands from becoming more than negligible or minor. Ash from prescribed burns could add nutrients to soils and water, with possible negligible benefits. Impacts to water quality from herbicide spraying would be short-term and no more than minor; algae production may be stimulated if low levels of herbicide enter dune hollows or slacks. The exposure of stockpiled sand to wind and water erosion may increase sedimentation in the short-term, a negligible or minor localized effect. In the long-term, remobilizing sand movement could fill in small wetlands completely and reduce the size or period the dune slack stays wet, a minor to moderate, localized adverse effect. Burial of the site's unique fen-like sedge wetlands would be a particularly adverse impact should it occur. Cumulative impacts from pathogens and nutrients from cattle grazing would likely be adverse, although cattle may help in keeping wetlands from filling in where they are able to access vegetation. Fencing cattle from all dune locations is called for in the park's General Management Plan, which would both prevent adverse and possible beneficial impacts from grazing.

No impairment to park water resources would occur if Alternative B were implemented.

Impact of Alternative C

Analysis

Staging and Access

As in Alternative B, staging or access routes would be sited to avoid wet areas at the study area, and no or only negligible indirect impacts to water resources from increased compaction and runoff or erosion from either access routes or the staging area itself would occur.

Impervious surfacing at the staging facility, a spill cleanup plan, daily inspections of equipment for fuel leaks and training of NPS staff and contractors at the site on spill response procedures would be in place as it would in Alternative B. The combination of these mitigation measures and locating access routes and staging areas away from dune slacks or dune hollows would keep impacts to water resources from staging or fuel leaks during access to no more than negligible.

Treatment Activities

In Alternative C, the only treatment activity that may affect water resources in the short term is the stockpiling of sand during excavation. Because excavation would be site-wide among *Ammophila* infested areas in this alternative, the chance of windblown sand or erosion from rainfall affect turbidity or filling in some portion of smaller wetlands is higher than in Alternative B. Because sand would not be stockpiled for more than a short period of time in any one location, the impacts to water resources from erosion are expected to be no more than minor and short-term.

Long-term impacts would be identical to those described above for Alternative B, and could be minor to moderate, localized and long-term if they result in the filling of some of the more unique wetlands at the site.

Sea Level Rise, Wave-Induced Erosion, and Surge Protection

As many of the impacts from climate change are not anticipated to affect coastal areas in the immediate future, most of the impacts for Alternative C would be similar to Alternative B, because they differ principally in the method of construction, not long-term maintenance. As with Alternative B, Alternative C would restore natural dune processes, thereby enabling

the dune systems to move or migrate in response to sea level rise and wave-induced or wind-induced erosional pressures. While excavation would be expected to leave the Project Area site more "mobile" than using a combination of excavation, burning, and herbicides would under the initial treatment, within a few years, native vegetation should have established would be expected to have colonized areas restored under both Alternatives B and C, and so differences would be minimal, and additional impact related to wind-induced erosion of mechanically destabilized dune areas would probably not occur during the timeframe in which winds would be expected to increase relative to baseline conditions. Therefore, minor to moderate beneficial effects on hydrologic-related dune functions such as storm surge protection and groundwater filtration would be expected under Alternative C similar to Alternative B.

As has been described under Alternative B, most of the removal efforts would be concentrated in the first 3 years of the project, with retreatment effort by herbicide or by hand removal decreasing over time. Climate change effects may not necessarily impact construction, but could impact maintenance. Should winds increase in strength or frequency of winds over 10 mph, the number of days in which spraying can be conducted may be reduced substantially, thereby requiring more hand removal efforts. Spraying would not be conducted within 24 hours of likely or actual precipitation, so any increase in the frequency of precipitation could limit opportunities for chemical retreatment. Increased heavy fog conditions, which also constrains the use of herbicides, could also affect maintenance options. Climate change effects are more likely to have an effect in later years (at least five years post-construction), when the scale of maintenance needs has declined, so, therefore, differences between Alternative B and Alternative C with regards to how these alternatives affect response or resilience of the project or these systems to hydrologic effects of climate change is negligible.

Cumulative Impacts

Impacts would be the same as described above for Alternatives A and B. Overall, the proposed project would be expected to have minor beneficial effects on both dune hydrologic function and overall viability of the Seashore's 1,700-acre dune system by reducing the intensity of hydrologic impacts from climate change to at least 300 acres.

Conclusions

Storing equipment, chemicals and fuel at the staging site would have no more than negligible short-term impacts to water resources because the area would be impermeable and bermed. Short-term increases in sedimentation from eroded stockpiles of sand would be minor, and long-term filling of some wetlands, particularly unique wetlands at the site, would be minor to moderate and permanent.

Cumulative impacts from pathogens and nutrients from cattle grazing would likely be adverse, although cattle may help in keeping wetlands from filling in where they are able to access vegetation. Fencing cattle from all dune locations is called for in the park's General Management Plan, which would both prevent adverse and possible beneficial impacts from grazing.

Minor to moderate beneficial effects to important dune hydrologic functions such as storm surge protection and filtration of groundwater could result from restoration of the dunes by enabling them to migrate in response to sea level rise and wave- and wind-induced erosion and thereby enhancing long-term system viability.

No impairment to park water resources would occur if Alternative C were implemented.

CULTURAL RESOURCES

Policies and Regulations

The NPS is charged with management and protection of cultural resources through a variety of guidance documents and legislation in which NPS managers avoid, or minimize to the greatest degree practicable, adverse impacts on park resources and values.

The National Historic Preservation Act (NHPA), as amended, is the principal legislative authority for management of cultural resources located within national parks. It requires federal agencies to strive to minimize harm to historic properties that would be adversely affected by an undertaking. Section 106 of the NHPA requires all federal agencies to consider the effects of their actions on cultural resources determined eligible for inclusion in the National Register of Historic Places (NRHP) (see discussion below). Section 110 of the NHPA, among other things, charges federal agencies with the responsibility to establish preservation programs for identification, evaluation and nomination of cultural resources to the NRHP.

NPS-28: Cultural Resources Management Guidelines (NPS 1998) provide the fundamental basis for managing cultural resources in the National Park System. This guidance document contains park management standards and other requirements for cultural resources, including archeological resources, historic and prehistoric structures, museum collections, cultural landscapes and ethnographic resources.

Section 106 Compliance

This cultural resource analysis is intended to comply with the requirements of both NEPA and section 106 of the NHPA (36 CFR 800, Protection of Historic Properties).

Section 106 of the National Historic Preservation Act mandates that federal agencies take into account the effects of their actions on properties listed or eligible for listing in the National Register. Under the ACHP's regulations, a determination of either adverse effect or no adverse effect must be made for affected NRHP-listed or eligible cultural resources. An adverse effect occurs whenever an action in an alternative alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the NRHP. Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur

later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, Assessment of Adverse Effects). The resolution of adverse effects can occur in a variety of ways, in accordance with 36 CFR 800.6 (Resolution of Adverse Effects). A determination of no adverse effect means there is an effect, but the effect would not diminish, in any way, the

impact on wilderness resources and values than hand tools given the pace of encroachment by *Ammophila*.

The Seashore currently contains approximately 33,000 acres of designated or proposed wilderness in which human modifications and uses are minimized to the extent possible. In the past, wilderness lands have incurred both cumulative adverse and beneficial impacts. For instance, Tule elk and nonnative deer management within the Seashore has resulted in short-term adverse (use of motorized vehicles in wilderness areas) and long-term beneficial (enhancement of wilderness) effects. Coastal restoration projects have resulted in short-term, adverse (project implementation) and long-term beneficial (restoration of natural processes) effects to wilderness lands.

Conclusion

Small-scale restoration efforts would have negligible to minor, adverse, localized effects on wilderness uses of adjacent lands.

Impacts of Alternative B

Alternative B includes the creation and use of two staging areas, both of which are located within G Ranch. One would be located on the existing NDOC facility property and require little improvement. The second is located near the southeastern project boundary (figure 5) at the AT&T site. The primary vehicular route for equipment and crew transport for all alternatives would be via an existing road from the NDOC facility which runs to the west for a short distance to the dunes area across G Ranch. This roadway would be improved (graded/graveled) prior to use. Two secondary, north-south unimproved routes created to allow access to the project site cross both G Ranch and ATT parcels, both of which are used for grazing operations. The third route is located within G Ranch and crosses the project site from east-west from the western-most staging area. This route would provide heavy equipment access to foredune areas.

No access would be routed through land used for grazing operations, and no direct impact on cattle is expected. Noise from the use of roads and access routes by even heavy equipment is also not expected to affect grazing cattle, as they are currently habituated to vehicular traffic, including ATVs. All project work would be coordinated with ranching permitees to minimize the potential for conflict, such as when cattle may need to be moved across roads to adjacent pastures. As a result, only negligible adverse, short-term, localized effects to ranching from staging or access within these two parcels (ATT and G) are expected.

Herbicide application would be done in coordination with both ranching permittees. As of 2008, G Ranch is certified organic. As such, no herbicide would be allowed within the ranch boundaries. In addition, in keeping with the guidelines from the Organic Crop Workbook published by NCAT, a 25-foot buffer between spraying of herbicide and adjacent areas certified as Organic Crop or Organic Livestock would be maintained. This buffer has been agreed to as being sufficient by both the ranching operators and the Marin County Department of Agriculture - Weights and Measures (John DiGregoria, 2009, *pers. comm.*). For this reason, impacts from use of herbicide on adjacent ranching operations would be considered negligible adverse short-term.

Increased mobility of dunes could result in landward migration of dunes into current ranching leaseholds. All of these ranch lands and other park lands along the coast represent former dune sands that have moved inland in response to winds and wave action. Centuries of grassland establishment and subsequent organic matter deposition have transformed these once granular, relatively nutrient-poor, well-drained soils into fertile

pastures. As was discussed earlier under Soils and Sand Movement, Ammophila removal areas at Little River State Beach in Humboldt County experienced sand movement at a rate of 0.11 cubic meters/square meter/yr or 1 cubic meter/square meter every 10 years (California Department of Parks and Recreation 2005). Sand movement was also assessed after some of the Seashore's earlier restoration efforts, and most of the movement documented appeared to involve redistribution of sand within the treated area rather than actual movement of sand (Peterson et al. 2003). In natural dune areas, some of the more mobile portions such as parabolic dunes can move as much as 1.4 m/yr (4.7 ft/yr) based on assessment of dune mobility at Humboldt Bay's North Spit between 1939 and 1988 (Pacific Watershed Associates 1991 *in* Pickart and Sawyer 1998).

To determine the rate of dune migration inland, monitoring stations would be established by the NPS on the perimeter of the Project Area to track the extent and rate of movement of dunes, which would enable determination of whether sands have moved into neighboring lands and, if so, whether usable grazing lands have been affected. This information would be integrated into the reappraisal process the park conducts every five years for ranches operated on park lands. Because of mitigation measures, impacts to ranches from dune migration would be long-term, but no more than minor.

Prescribed burning would create smoke and odors, and the potential for intrusions of obvious human activity and management (e.g., herbicide application) into an otherwise natural wilderness experience on adjacent wilderness lands. Although wilderness visitors would generally not be aware of herbicide use, those that are would potentially find it in conflict with wilderness values that normally do not include management activities or the use of potentially toxic chemicals.

Wilderness uses of adjacent areas could also be adversely affected by the visual presence of work crews and heavy equipment for excavations, as well as the presence of noise and odors related to the use of heavy equipment. These potential intrusions into adjacent wilderness lands would last approximately two months. Wind and wave action can often mitigate adverse noise and odor effects (see Visitor Experience above). Collectively, these

noise, odor and visual intrusions would likely result in negligible to minor, localized, short-term and adverse impacts to those using wilderness lands adjacent to the project site.

Cumulative Impacts

Approximately 21,000 acres encompassed within the Seashore boundaries represents active ranching land uses (NPS 2008 p. 204). Ranching land uses often overlap with other land uses such as transportation, residential, and park management.

Cumulative impacts to wilderness lands adjacent to the project site under Alternative B are similar to those described for the No Action alternative, with additional negligible to minor, adverse effects related to project implementation (noise, odors, increased activity). Potential cumulative impacts on ranchlands in the park from dune migration would be expected to be negligible overall.

Conclusion

The implementation of Alternative B would result in negligible, adverse, short-term, localized impacts to ranching land uses adjacent to and overlapping the project site. Localized, short-term, negligible to minor adverse effects to those using wilderness lands to the west and north of the project site from smoke, odors, herbicide use and noise are also expected. Additional long-term negligible or minor adverse impacts from increases in sand migration and loss of usable pasture land are also possible. Impacts to organic ranching practices from herbicide application would be minimized through the use of buffers. When compared to the No Action alternative, Alternative B would result in similar adverse effects to adjacent ranching and wilderness land uses.

Impacts of Alternative C

The impact of access and staging under Alternative C to adjacent land uses would be similar to that described above under Alternative B--negligible adverse, short-term, and localized.

Though similar in nature to those under Alternative B, effects to adjacent wilderness users associated with excavation would be more extensive under Alternative C. Excavation would take place Monday through Friday during the day for a five month period in this alternative. For those visitors accessing adjacent wilderness along the Abbotts Lagoon path, or visiting beaches in wilderness areas adjacent to the site, noise and odors may be obvious during certain periods of time. If so, they would be out of character with wilderness and have at least a minor impact on those using these adjacent lands. When excavation is taking place further from the trail or beaches, noise would be dampened by distance, wind and topography, and may not be noticeable. In either case, excavators would be visually apparent for some visitors and would be out of character with and disruptive to the usual wilderness experience near the site. Short-term, localized, adverse impacts would range from negligible to moderate.

In addition, in keeping with the guidelines from the Organic Crop Workbook published by NCAT, a 25-foot buffer between spraying of herbicide and adjacent areas certified as Organic Crop or Organic Livestock would be maintained. This buffer has been agreed to as being sufficient by both the ranching operators and the Marin County Department of Agriculture - Weights and Measures (John DiGregoria, 2009, *pers. comm.*). There would be less use of herbicide under Alternative C during initial treatment, so that would represent less of a potential impact to ranching operations. Therefore, potential impacts would be short-term and negligible to minor at most.

Impacts associated with potential dune migration into adjacent ranch lands would be similar to those described under Alternative B. As with that alternative, monitoring stations would

be established by Park Service on the perimeter of the Project Area to track the extent and rate of movement of dunes, which would enable determination of whether sands have moved into neighboring lands and, if so, whether they have affected grazing lands. This information would be used in the reappraisal process conducted every 5 years for ranches operated on park lands. Because of these mitigation measures, impacts to ranches from dune migration would be long-term, but no more than minor.

Cumulative Impacts

Cumulative impacts under Alternative C are similar to those described for Alternative B, with additional negligible to moderate, adverse effects to those using adjacent wilderness lands. These additional effects would be related to project implementation (noise, odors, increased human activity). Potential cumulative impacts on ranchlands in the park from dune migration would be expected to be negligible overall.

Conclusion

The implementation of Alternative C would result in negligible, adverse, short-term, localized impacts to ranching land uses adjacent to and overlapping the project site. Localized, short-term, negligible to moderate adverse effects to those using wilderness lands to the west and north of the project site are also expected as a result of noise, odor and visual intrusions into wilderness areas. When compared to the No Action alternative, Alternative C would result in slight elevated adverse effects to adjacent wilderness land uses related to the extended period of heavy equipment. Additional long-term negligible or minor adverse impacts from increases in sand migration and loss of usable pasture land are also possible. Impacts to organic ranching practices from herbicide application would be minimized through the use of buffers.

Section II: Comment and Response Summary

The Seashore has responded to those comments considered substantive (e.g. question a fact or alternative, ask for additional information, etc.) below:

Commenter felt that herbicides should not be used, because they are poisonous and may start a chain reaction; removal should be done manually, which would be better for the economy. Should specify in the document the type of herbicide to be used and method of application.

Response: The Seashore has attempted to resolve issues of concern regarding herbicide use through stringent mitigation measures. Once European beachgrass is removed, native vegetation is expected to quickly recolonize. Use of mechanical excavation to remove resprouts of European beachgrass once initial construction is completed would not be appropriate, because it could damage establishing vegetation, and use of hand-removal would not be feasible or cost-effective in a 300-acre project area. Spraying would only be conducted in dry conditions with low wind speeds (<10 mph) using a backpack sprayer and a calibrated, directed nozzle applicator. Buffers would be established around rare plants and sensitive vegetation communities such as wetlands, dune mat, and other wildlife habitat areas. Since the 1980s, the Seashore has operated under an Integrated Pest Management program, and a key part of this national program is that only the least toxic chemicals can be requested for use. Proposed chemicals can be used only with approval through an independent review and approval process. In the document, glyphosate is listed as the product that would be used for treatment of re-sprouts. Choice of glyphosate is based on the best available information on the most effective and least environmentally damaging approaches at this time. However, should information become available from other resource managers on more effective, ecologically appropriate, or cost-efficient approaches, a different herbicide or mix of herbicides may be employed. As part of this project, approximately 1 acre of the iceplant would also be removed by hand, with biomass buried along with European beachgrass. Treatment of iceplant resprouts may also be conducted using herbicide.

Support implementation of mitigation measure that would ensure that there would be no staging near Abbotts Lagoon after July 30 so as to avoid disturbance to fall migration of birds using this valuable habitat.

Response: The Seashore agrees and will implement this mitigation measure.

Commenter has concerns about impacts of proposed project on California Native Plant Society (CNPS)-listed species

Response: While the Seashore is legally obligated to protect federally listed species, as part of its mission to conserve and protect natural resources, it also monitors and strives to conserve and protect state- and CNPS-listed rare plant species. Where impact is unavoidable, the Seashore employs stringent measures to reduce or mitigate impacts. The Seashore has conducted surveys for all plant species of concern at the project area. Surveys would be repeated again this year to provide the most updated information for creation of buffer areas in final design. As noted above, buffers would be established around rare plants and sensitive vegetation communities, and only hand removal of European beachgrass would be allowed in these areas.

Support mitigating impacts to visitors, particularly birders, by ensuring that information about the disruption of the natural soundscape by mechanized

Response: The Seashore would implement mitigation measures to avoid, reduce, or mitigate impacts to migrating shorebirds at Abbotts Lagoon in the fall and to park visitors wanting to visit Abbotts Lagoon who might be dismayed by the noise from construction equipment in this normally quiet environment. These include avoiding staging near Abbotts Lagoon after July 30 to avoid disturbance to fall migrants to protect shorebirds. Impacts to the visitor experience would be minimized by working on weekdays, and by providing educational materials to visitors indicating that restoration is ongoing as the commenter has identified.

Should specify in the document the approach for removing ice plant (*Carpobrotus* sp.).

Response: The document indicates iceplant would be removed by hand, although resprouts may be treated with herbicide.

Mitigation measures proposed for wetlands are ones that are intended to reduce long-term, indirect impacts from dune mobilization, not short-term, direct impacts from construction. Therefore, this element would not be implemented in advance of construction, but would be conducted simultaneously

Note that any impacts to state highways from increased traffic needs to be adequately addressed in a traffic study, mitigated, and permitted by the California Department of Transportation through an encroachment permit.

Response: Most of the roads in the vicinity of the Project Area are county roads, with the nearest state-maintained facility being State Route 1 near Olema and Point Reyes Station. The Seashore does not anticipate impact on traffic or road conditions on State Route 1 resulting from implementation of this project. Use of these facilities would be limited to mobilization and demobilization periods and daily employee traffic, none of which should affect Level of Service (LOS) on these roads. LOS on State Route 1 north and south of Point Reyes Station has been classified in recent years as ranging from Level B to Level C (DKS Associates *in* EDAW 2001) and would not be expected to drop below Level D.

Should include in the document a timeline showing duration of each of the alternatives, including how unacceptable environmental constraints will be avoided. Should include cost estimates for each of the alternatives, including appropriate contingencies and what added costs might result from funding delays

Response: A timeline for implementation of construction would be part of the package supplied by contractors chosen to implement the proposed project, although final design specifications would provide information to the contractors on "windows" when construction in and around certain areas could not occur to assist in developing these timelines. Preliminary cost information was provided in the document.

Advocate better protection of wetland and dune habitat on adjacent ranch lands from grazing. Request that fencing be improved to allow easier access by the public onto public lands

Response: *These are outside the scope of this project.*