Malibu Living Shoreline Project:
Baseline Assessment and Site Characterization

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with additional supplemental data and review by:

The Bay Foundation

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1) INTRODUCTION

This document is a supplemental site evaluation report to summarily characterize historical and existing conditions for Zuma Beach and Point Dume Beach within and adjacent to the areas proposed for restoration as part of the Malibu Living Shoreline Project (Figures 1a and 1b). For additional details on the restoration plan, please see the Malibu Living Shoreline Project: Implementation and Monitoring Plan (Johnston et al. 2020). Surveys contained within this document were primarily conducted by expert coastal scientists from Coastal Restoration Consultants, Inc. (CRC). Supplemental surveys were also conducted by scientists at The Bay Foundation (TBF), with support from Loyola Marymount University's Coastal Research Institute. Data are summarized in the "Existing Conditions" section below. Additional baseline surveys will be conducted prior to restoration activities.

The proposed restoration sites at Zuma Beach and Point Dume Beach have good potential for supporting more natural coastal habitats because they retain mostly intact coastal processes. Restoration actions that remove impediments to natural functioning and restore native plant communities will lead to habitats that support native species and make the coast more resilient as sea level rises. The remnant coastal dunes at Zuma Beach and Point Dume Beach seem to have somewhat stable sediment fluxes and are perhaps the best examples of natural dunes in the 17-mile long (27 km) Zuma Littoral Cell (Griggs and Patsch 2018), which lies between Point Mugu and Point Dume. On the other hand, the proposed restoration areas are under pressure from compromised sediment supplies from up-coast sources (estimated to be at approximately 75% of historical levels by Griggs and Patsch (2018)), localized driving and trampling, negative interactions with infrastructure and current management, and invasive non-native plants (Figure 1a).

The natural and human-caused processes surrounding beach erosion in this area are complex but are nonetheless important in the context of restoring coastal dunes. Interested readers should consult Griggs and Patsch (2018) for a thorough discussion. This restoration plan provides information on historical and current conditions in dune and related habitats in the project area and then outlines steps for restoring natural coastal ecosystems at the site.

Figure 1a. Photograph of Zuma Beach restoration area adjacent to Zuma Lagoon (left).

Figure 1b. Overview map of both restoration areas as part of the Malibu Living Shoreline Project (Rios and CRC 2019).

2) HISTORICAL ECOLOGY

Historical ecology is the study of how humans have interacted with natural landscapes over time. A basic tenant of this field is that different societies alter ecological landscapes in different ways. Societies in turn adapt their practices to the altered landscapes and over time; societies and landscapes evolve together. In southern California, there are generally three major shifts in human uses of the landscape: 1) early human arrival, 2) the Spanish and Mexican years, and 3) the population boom.

Humans probably arrived in southern California about 13,000 years ago near the end of the last major period of glaciation. Over the ensuing millennia, the climate warmed and human societies interacted with the natural landscapes in many ways. During the early part of this period, the diverse megafauna that characterized much of California went extinct. The loss of these huge grazers probably had a significant impact on plant communities. We also know that these human societies manipulated landscapes with fire, moved species around (intentionally or otherwise) and employed various forms of agriculture. All in all, it is safe to assume that by the time the first Europeans arrived in California, the landscape looked very different than it did when humans first arrived.

The greater Malibu area was part of the Rancho Topanga Malibu Sequit, a Spanish land grant made in 1805 to Jose Bartolome Tapia. The approximately 14,000-acre rancho stretched along the coast from about Topanga Canyon to Point Mugu and from the coast to the first high ridge of the Santa Monica Mountains. The Rancho was bought by the millionaire Frederick Hastings Rindge for $10 an acre in 1892 (the previous owner bought it for 10 cents an acre in 1857). The Rindge family used the property primarily for grazing cattle in the hills and dry-farming lima beans and barley along the coast. The family famously fought to keep outsiders off of their ranch, including the Southern Pacific Railroad (successfully) and later road builders (unsuccessfully). Today's Pacific Coast Highway was first opened as a county road in 1921, and then improved to a state highway in 1929. The building of roads brought some of the early major impacts to dunes, creeks, and beaches along the Malibu coast. With the building of the road came development in the 1930's and 40's. In 1941, Los Angeles County foreclosed on a large property at Zuma Beach for taxes due, and in the ensuing years, replaced a large area of dune habitat with an extensive parking lot. A road and parking lot were built on top of dunes in the mid to late 1940's at Point Dume Beach as well. Historic conditions that existed before major disturbances and changes over time can best be tracked through analysis of historic photos and maps.

The first detailed map of the Malibu coast was published in 1857 as part of the United States Coast Survey (Figures 2a and 2b). Aerial photos are available as far back as 1927 and the sequence shows interesting changes in habitats and land uses over time, generally from agricultural to developed land uses (Figures 3 and 4). The early photographs of the nearby coast show the conditions of dunes before significant development. Figure 5 is a 1936 photo of Trancas Beach approximately two miles north of Zuma Lagoon. Note wide zone of vegetated dunes extending nearly to the high tide line. Dunes were likely much taller than these at Zuma Beach and Point Dume Beach.

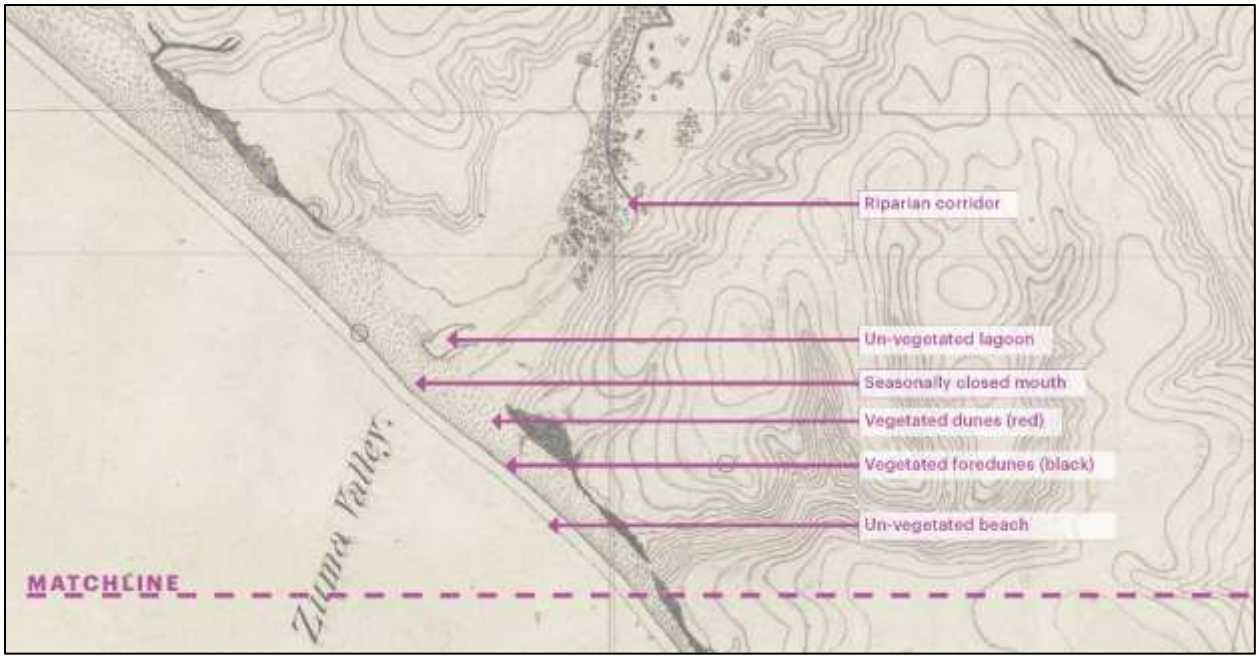

Figure 2a. 1857 Coast Survey of Zuma Lagoon and vicinity (replicated from Rios and CRC 2019). Vegetated foredunes are indicated by a black line and vegetated dunes are 'red' speckles on the map.

Figure 2b. 1857 Coast Survey of Zuma Lagoon and vicinity (replicated from Rios and CRC 2019). Vegetated foredunes are indicated by a black line and vegetated dunes are 'red' speckles on the map.

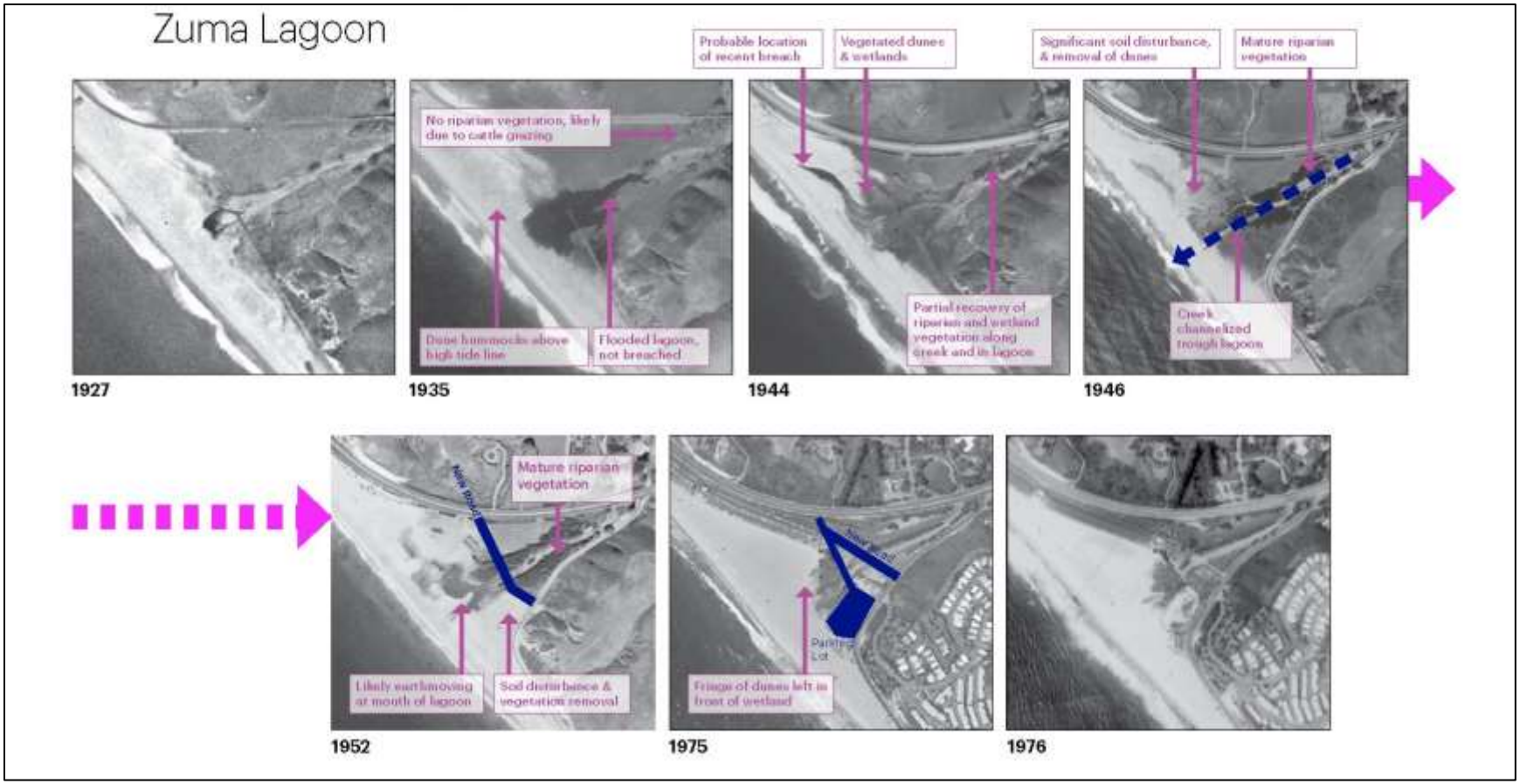

Figure 3. Historic aerial time series of Zuma Lagoon.

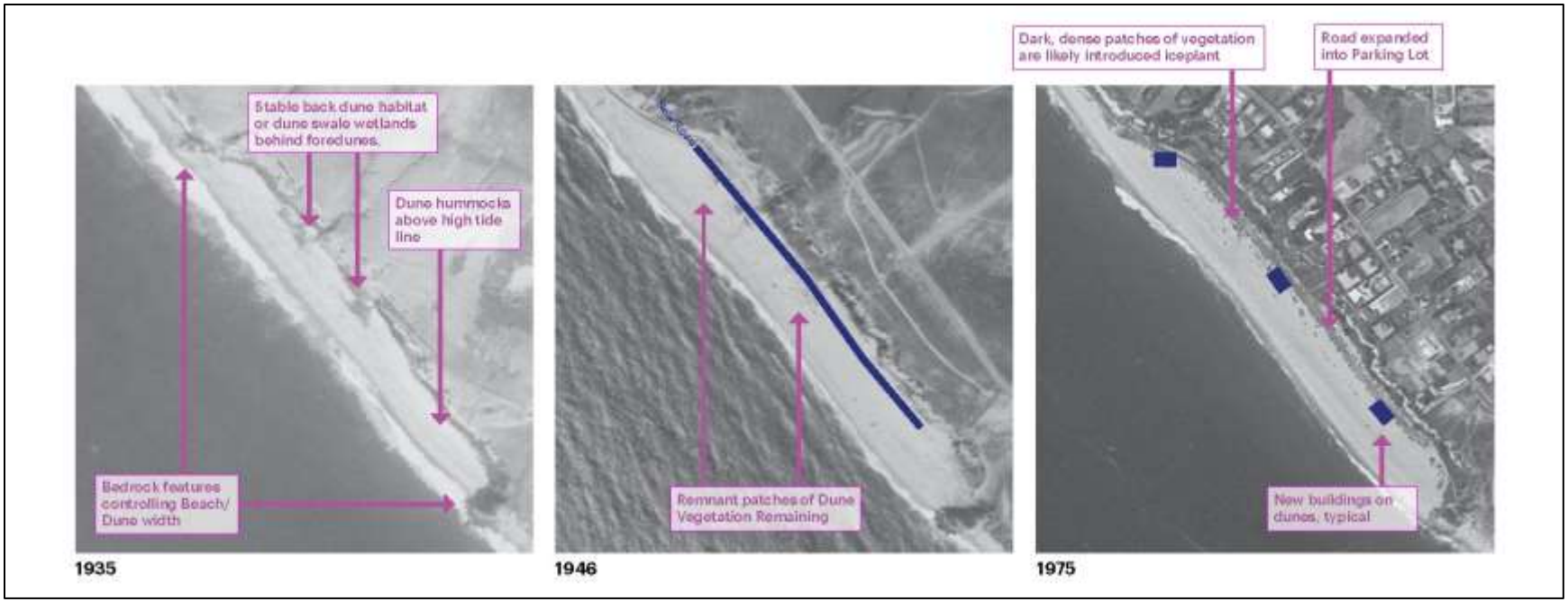

Figure 4. Historic aerial time series of Point Dume Beach.

Figure 5. 1936 photo of Trancas Beach (~2 miles north of Zuma Lagoon). Note wide zone of vegetated dunes extending nearly to the high tide line. Dunes were likely much taller than these at Zuma Beach and Point Dume Beach.

3) EXISTING CONDITIONS

Zuma Creek watershed (ten square miles) is 49.6% federal parkland, 0.6% state and 1.2% local parklands interspersed with 45.1% scattered single-family residences, suburban development, orchid nurseries, and a commercial complex located north of Pacific Coast Highway (PCH) (Dagit et al. 2018). Southwest of PCH is Zuma Beach, operated by LA County Department of Beaches and Harbors (LACDBH). City of Malibu is also an active partner in this project, and permitting will be conducted under the City's Local Coastal Program.

In April 2016, Los Angeles County published the LA County Public Beach Sea-Level Rise Vulnerability Assessment, made possible by a grant from the California State Coastal Conservancy. This assessment identified public beach facility assets at Zuma and Point Dume County Beaches, where the proposed Malibu Living Shoreline Project will occur. Collectively there are 33 assets, including a concession, multiple lifeguard buildings, a maintenance yard, parking lots, restrooms, and an access road at Zuma and Point Dume County Beaches. These assets comprise the essential components that are needed to support and promote safe public beach recreation opportunities. The study identified that if no protection measures are implemented, assets at Zuma and Point Dume County Beaches will be vulnerable to inundation damage under high sea-level rise projections. Additionally, with no shoreline protection measures implemented, the analysis suggests that Zuma and Point Dume County Beaches could lose up to 50% of beach by 2040, and up to 70% of beach by 2100.

Methods

To characterize existing vegetation and topographic patterns at both sites, fieldwork was conducted on 17 October 2018 (TBF), and March 22, 2019 (CRC). Data were collected for vegetation cover, elevation profiles, soil grain size analysis, and sediment organic content. The goal of the fieldwork was to collect data that would serve as a basis for setting restoration goals for the site but was not intended to be a full floristic survey or to characterize every species of wildlife.

At Point Dume Beach, CRC measured vegetation cover and elevations along nine transects, extending from the seaward edge of the parking lot to the high-tide line (Figure 6). Blue and light blue transects extended through vegetated dunes. Red and orange transects were surveyed through blowouts that had little or no vegetation. Vegetation percent cover was estimated for each species in 1-m^2 quadrats placed every two meters along each transect. Elevations for the parking lot edge, landward limit of dunes, dune crest, toe of dunes, and the high-tide line were surveyed using an auto level. The surveys were not tied in to any U.S. Geological Survey benchmarks (the closest one was too far away for practical use) but were all assessed relative to the elevation of a landmark (corner of the parking lot) and that elevation was estimated from Google Earth elevations of pavement surfaces. The elevations presented here are within +/- 2 feet of NAVD. Blue and light blue transects extended through vegetated dunes. Red and orange transects were surveyed through blowouts that had little or no vegetation. Transects are numbered north to south. TBF also conducted two elevation profile surveys with a higher resolution that illustrate relative change.

At Zuma Beach, creek flooding in the weeks prior to CRC's fieldwork caused significant erosion along the edges of the lagoon, and management of the County Beach included actively grading beach areas and removing flood-deposited debris. Because of this on-going disturbance to parts of the project area, topography was not measured. A general map of the site's vegetation was created based on dominant plant types. Two additional vegetation transects were monitored in October 2018 by TBF.

Figure 6. Point Dume Beach showing locations of vegetation/topography transects (CRC). Transects are numbered north to south.

Monitoring Results

Topography

The unvegetated blowouts at Point Dume Beach showed a continuous downslope from the seaward edge of the parking lot to the high tide line on the beach (Figure 7). Vegetated transects through dunes showed four to five feet of relief above the elevation of the parking lot before dropping down to beach elevations (Figure 7). These data suggest there is an opportunity to build four to eight feet of topography in blowout areas by trapping blowing sand. This increase in sand storage and elevation would provide a basis for assessing increasing resiliency to storm events and sea level rise. Blowouts (red and orange lines) were essentially unvegetated, did not have distinct dune crests, and were overall lower in elevation. Dunes (blue and green lines) were vegetated and had distinct crests. Elevations are approximately NAVD 88.

Figure 8 illustrates the elevation profiles from the two TBF elevation transects, which are in similar locations as the blue and green line transects by CRC (Figures 6 and 7), but with a higher resolution survey method, with a point taken approximately every 3 meters. Elevation profiles exhibit peaks in elevation due to the dunes adjacent to the parking lots but then a consistent and swift decline approaching the water with few other dune/hummock features.

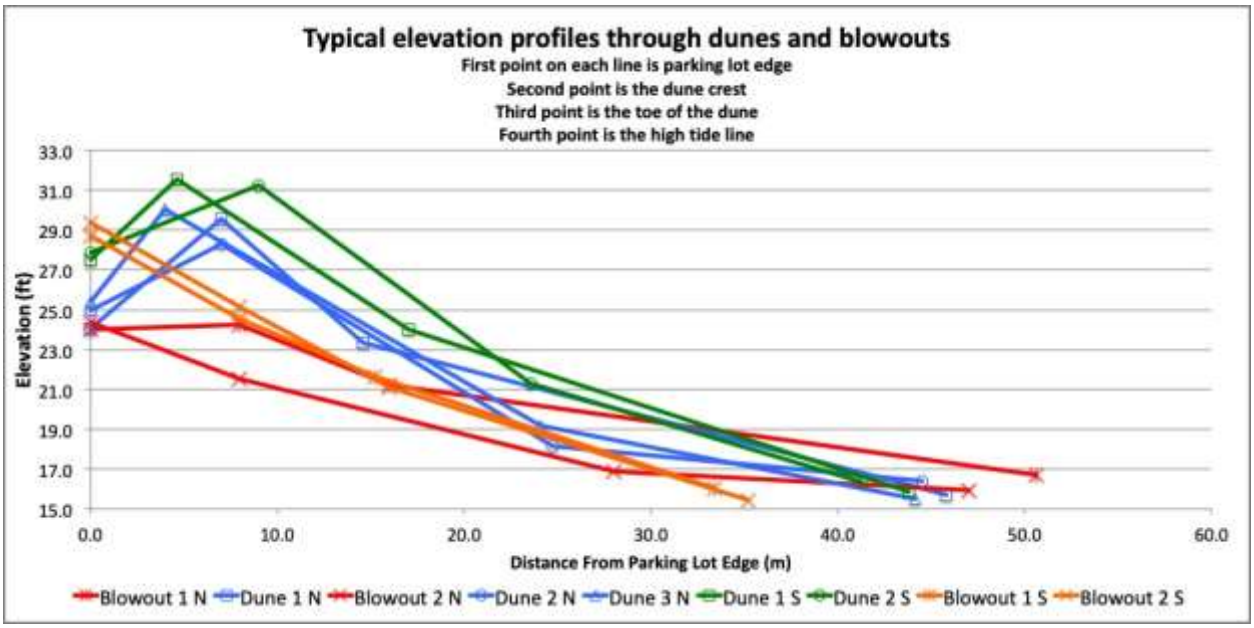

Figure 7. Elevations in feet at four points along nine shore-normal transects at Point Dume Beach vs. distance in meters (approximately 3 feet) from the seaward edge of the parking lot to the high tide level on the beach in March 2019 (CRC).

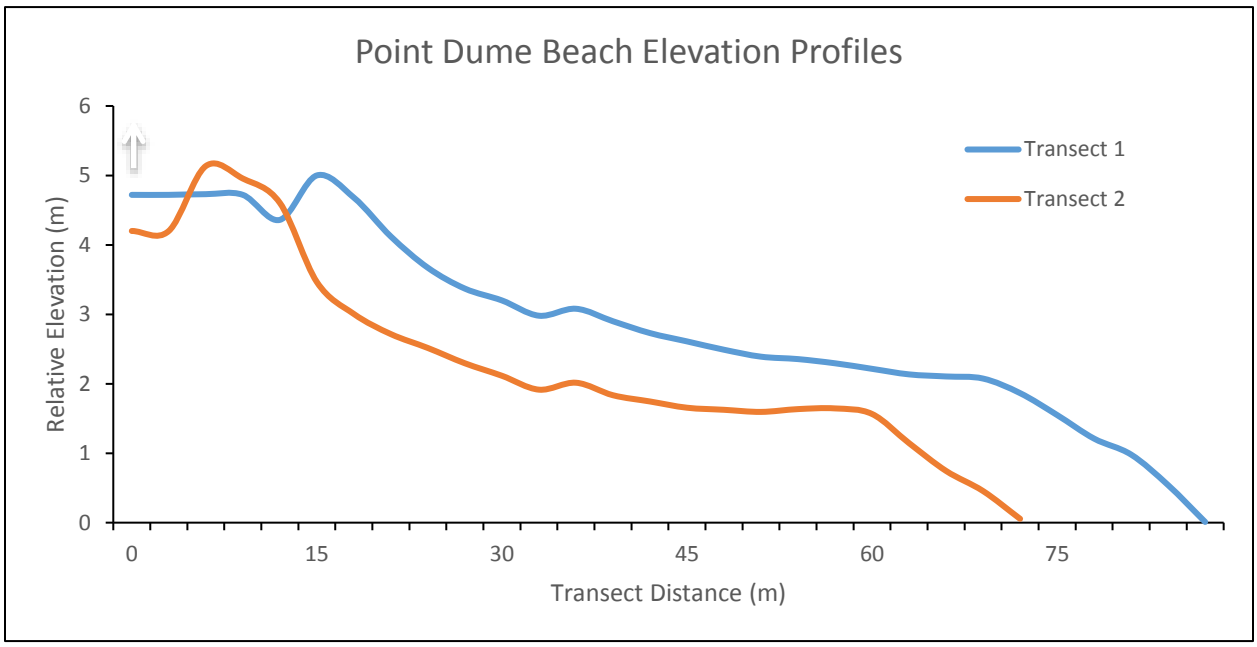

Figure 8. Two elevation profiles in similar locations as Figure 7, above, but with higher resolution (TBF).

Sediment Characteristics

Sand at the two restoration sites varied from very fine pebbles to very fine sand (Figure 9). Dominant sand types varied by site. At Zuma Beach, medium sand was the most dominant grain size type; at Point Dume Beach, coarse sand was the most dominant grain size type (Figure 9). Soil moisture of dry sand samples was seven-fold greater at the Zuma site (1.12%) than at the Point Dume site (0.15%). Average percent organic content was almost three-fold greater at the Zuma site (0.57%) than at the Point Dume site (0.20%). Both sites exhibited sand grain size and organic content reflective of southern California beaches. Higher soil moisture and organic content at the Zuma site may be attributed to different plant communities or soil conditions.

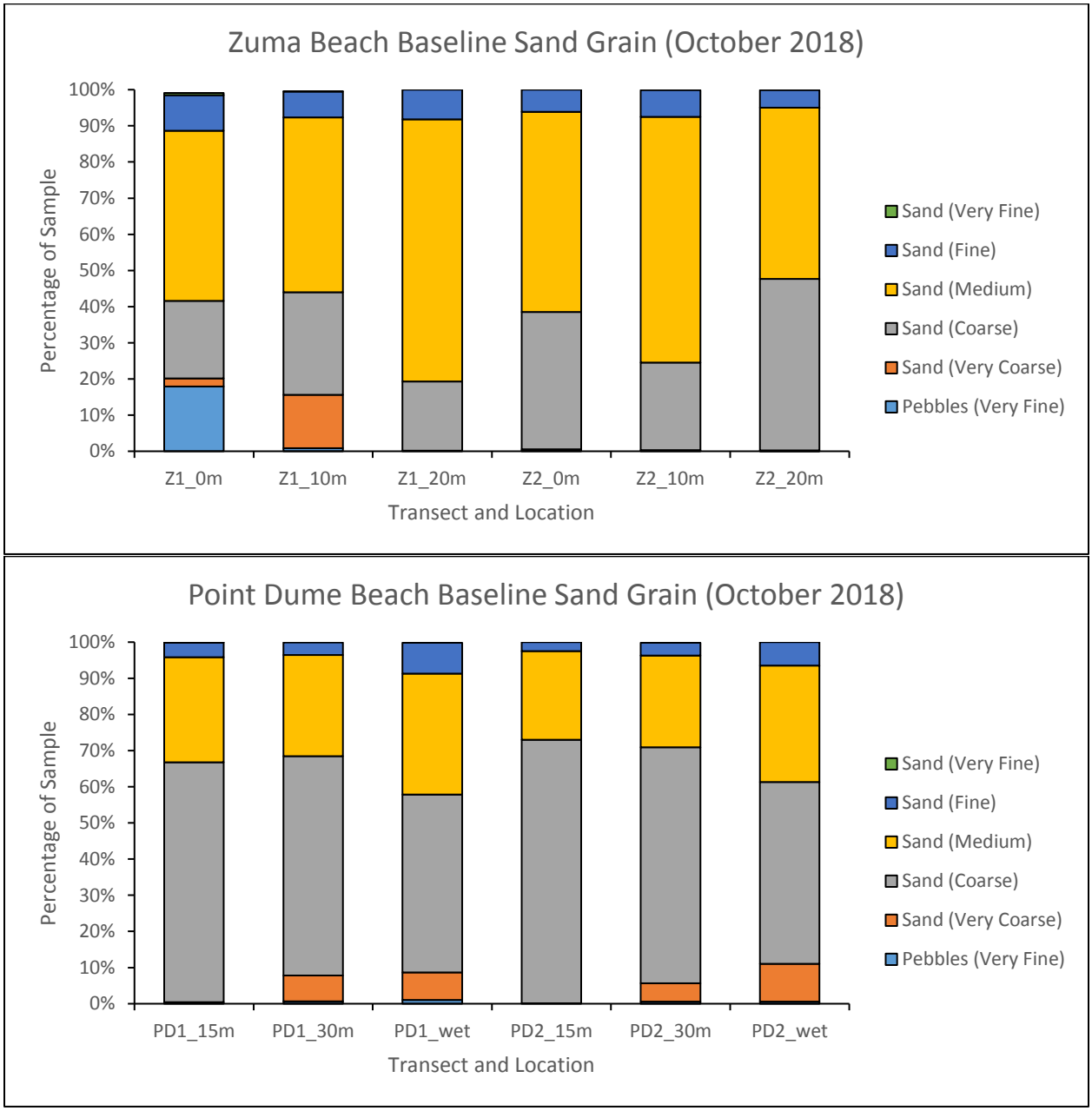

Figure 9. Grain size data from October 2018 for Zuma Beach (top) and Point Dume Beach (bottom) (TBF).

Vegetation Cover – Point Dume Beach

There were large differences in vegetative cover between transects in dune areas and blowouts at Point Dume Beach (Figure 10, CRC). This was due in large part to the methodology used for choosing transect locations (intentional variability in dune formation). The only plant species found in blowout areas was very small patches of the non-native annual plant European sea rocket (*Cakile maritima*), though it was not captured within the transects. As an annual species, European sea rocket does not typically produce dune topography. In the dune transects overall, there was a roughly equal mix of native (8.3% cover) and non-native (7.9% cover) species, but there was high variability between transects, with one transect identifying > 25% non-native cover, dominated by iceplant (*Carpobrotus edulis*). The four blowout transects all had zero vegetation cover. The majority of the native plant cover, when present, was beach bur (*Ambrosia chamissonis*) in small patches.

The majority of vegetation in dune transects was concentrated towards the inland end of the system (Figure 11 and top picture in Figure 12). The lack of vegetative cover on the seaward end of the transects (i.e., seaward of dunes) was primarily due to beach management actions, such as grooming, that kill seedlings. Widely scattered seedlings of European sea rocket were observed seaward of the dunes down to the high tide strand line (though our transects did not capture cover of any of these). This supports the idea that these areas seaward of existing dunes can support native vegetation under different management regimes. Appendix 1 includes a list of all plant species encountered during field work.

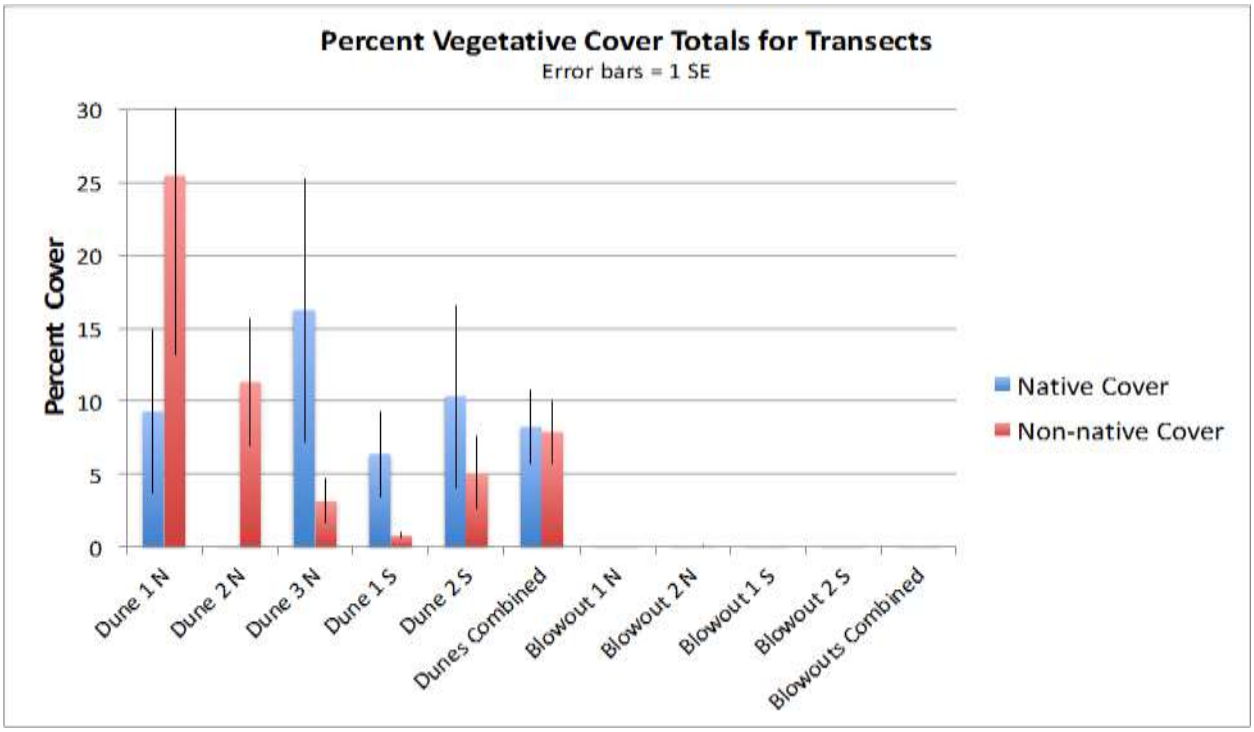

Figure 10. Percent cover of native and non-native plants in nine shore-normal transects at Point Dume Beach in March 2019.

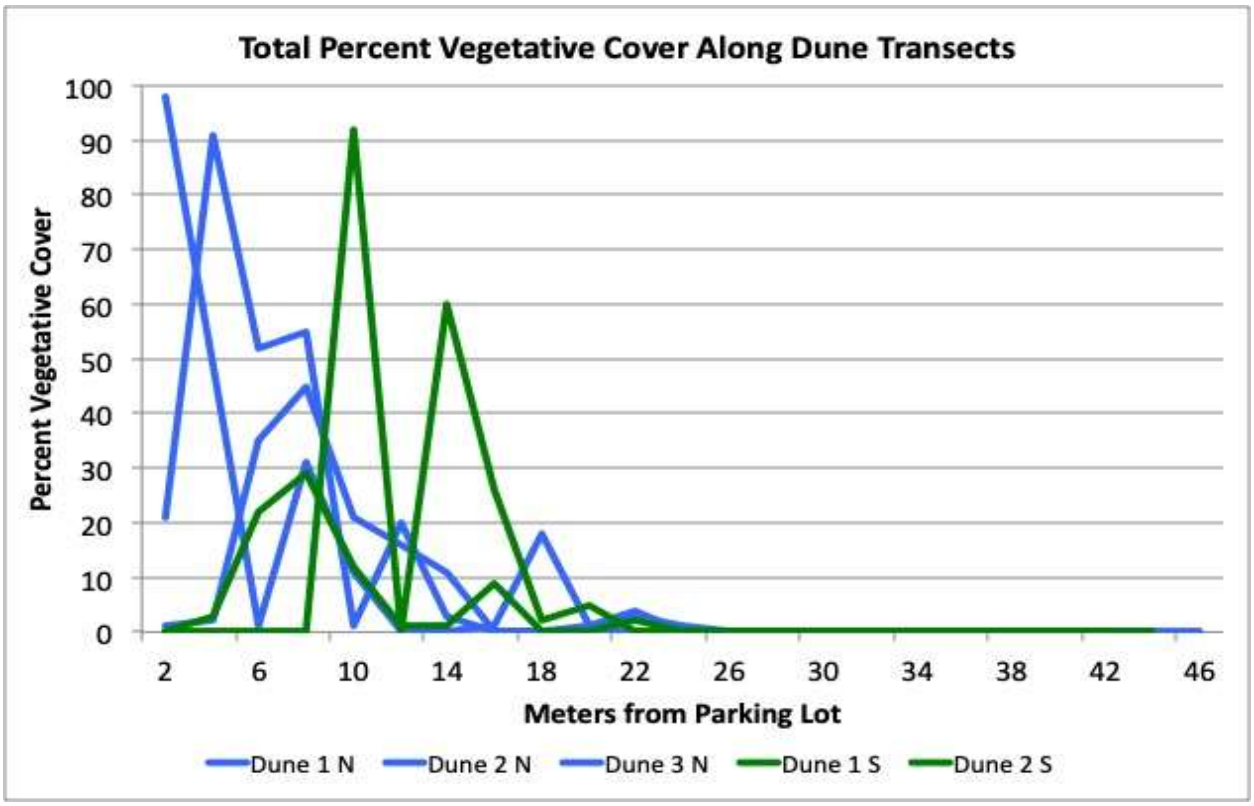

Figure 11. Percent cover along each vegetated dune transect estimated in one-meter square quadrats every two meters along each transect at Point Dume Beach.

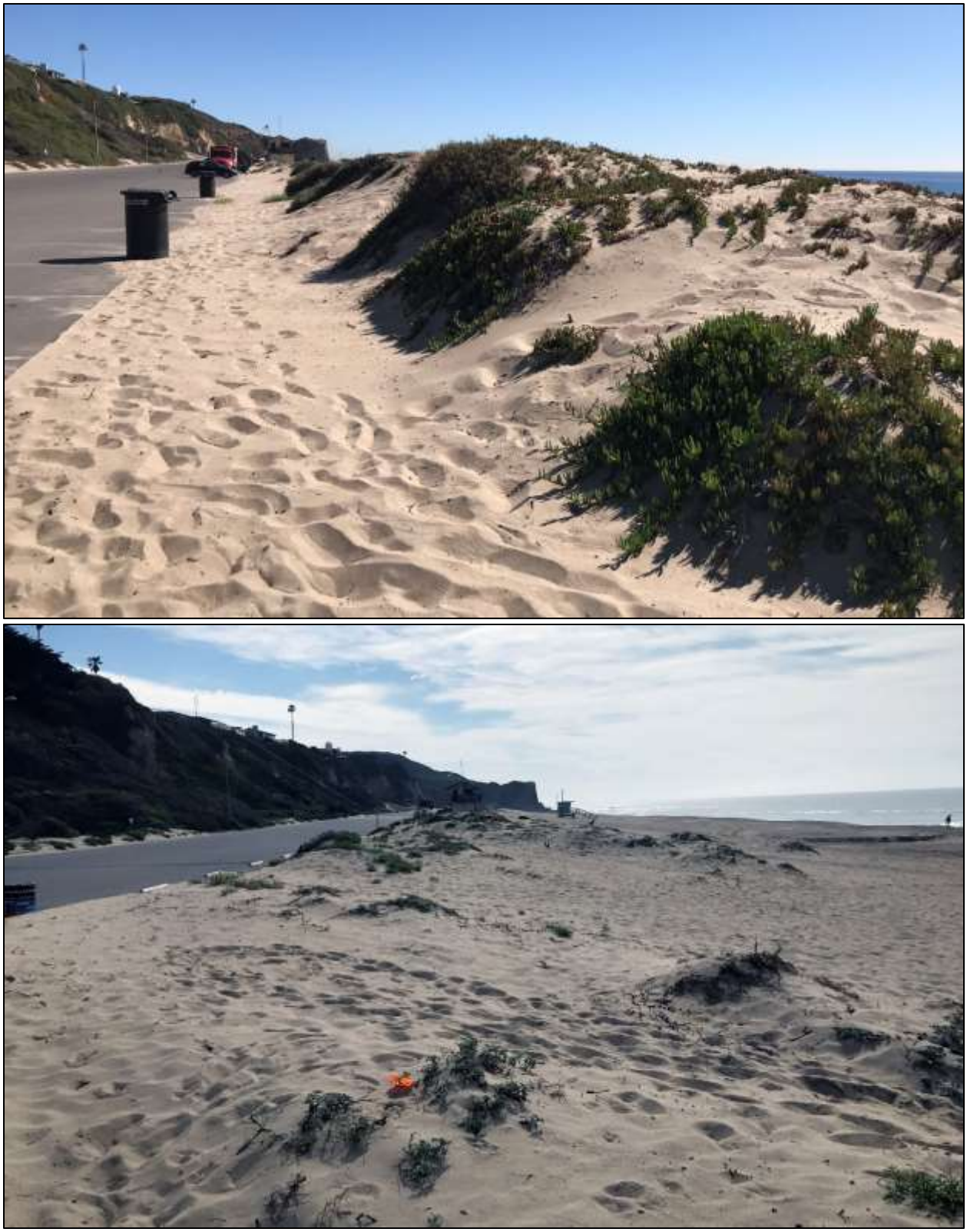

Figure 12. Photographs from Point Dume Beach at representative locations adjacent to a vegetated dune (top) and a blowout area with little vegetation (bottom).

Vegetation Cover - Zuma Beach

Average absolute cover of native species at Zuma Beach along two transects was found to be 9.2%, with 25.6% average non-native cover. Iceplant was found to be the predominant non-native species, individually contributing to the highest proportion of relative cover (53.1%) (Figure 13). The highest proportions of cover by native species were found to be beach saltbush (36.6%) and red sand verbena (6.9%). Overall, combined for both transects, relative non-native cover was 55.8% and native cover was 44.2%. Figures 14 and 15 are baseline photographs of representative areas within the Zuma Beach portion of the Malibu Living Shoreline Project restoration. Native vegetation (beach bur) can be seen in the foreground of both pictures, with invasive iceplant in the background.

Additional baseline vegetation transects will be conducted prior to restoration activities at both sites. These data were meant to broadly characterize the site and need for restoration actions in the non-native cover areas.

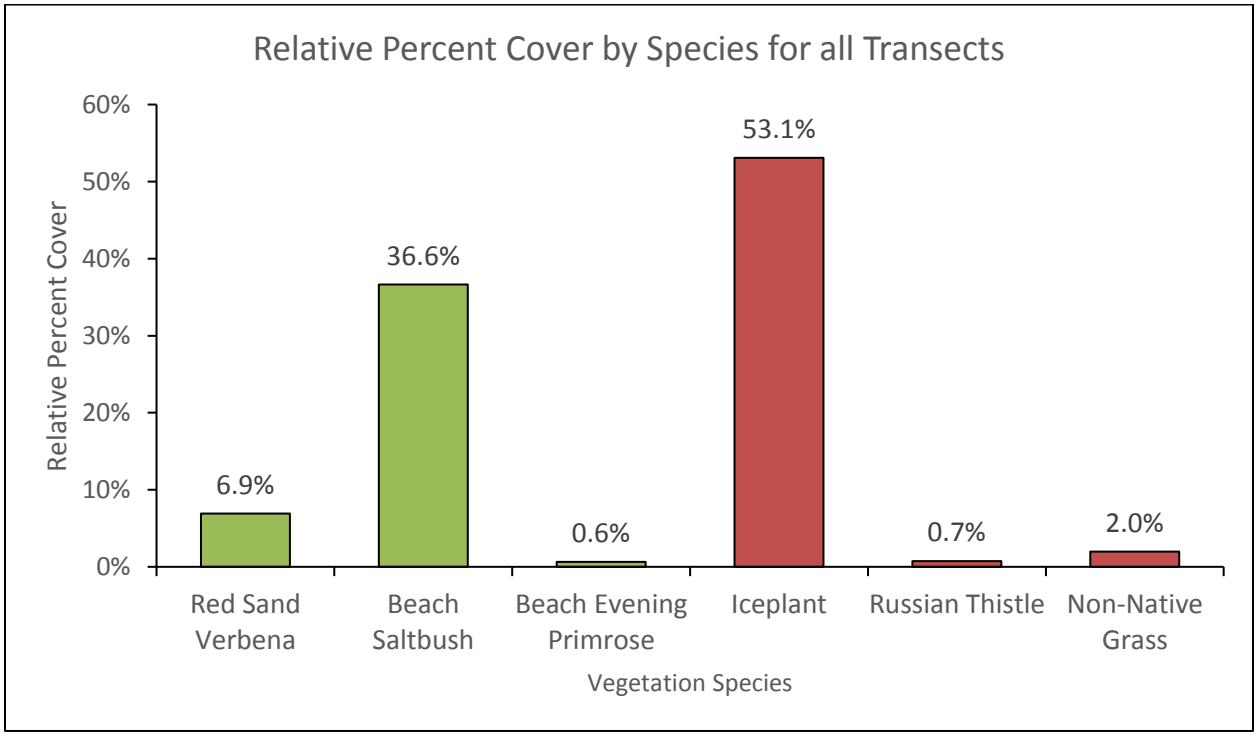

Figure 13. Relative cover by species for all transects at Zuma Beach combined (green indicates native species, red indicates non-native).

Figure 14. Photograph of one of the Zuma Beach transects showing mixed native and non-native vegetation cover.

Figure 15. Photograph within the restoration area facing the public restroom facilities at Zuma Beach.

Habitat mapping at Zuma Beach

The habitats in and adjacent to Zuma Lagoon are diverse and dynamic in space and time. To characterize existing conditions, CRC mapped general habitat categories as they were observed in March 2019. Eight different habitats were identified in the assessment area (Figure 16), which covered a total of 5.0 acres (Table 1), including areas such as willow riparian forest and open water that were adjacent to, but not within, the proposed restoration area. Habitat mapping included the approximately 1.1-acre restoration area and the surrounding 4-acre area, intending to broadly characterize the ecosystem and habitats surrounding the restoration area. Natural habitat boundaries were used to define the edges of the mapped area such as extensive mechanically groomed beach and Zuma Lagoon. No restoration activities are proposed within delineated wetland habitats or waters of the US. Analysis of recent aerial photos shows that approximately 0.12 acres of southern foredune habitat was lost due to flooding and erosion during the winter of 2018-19. Descriptions of habitats that were mapped follow Figure 16 and Table 1.

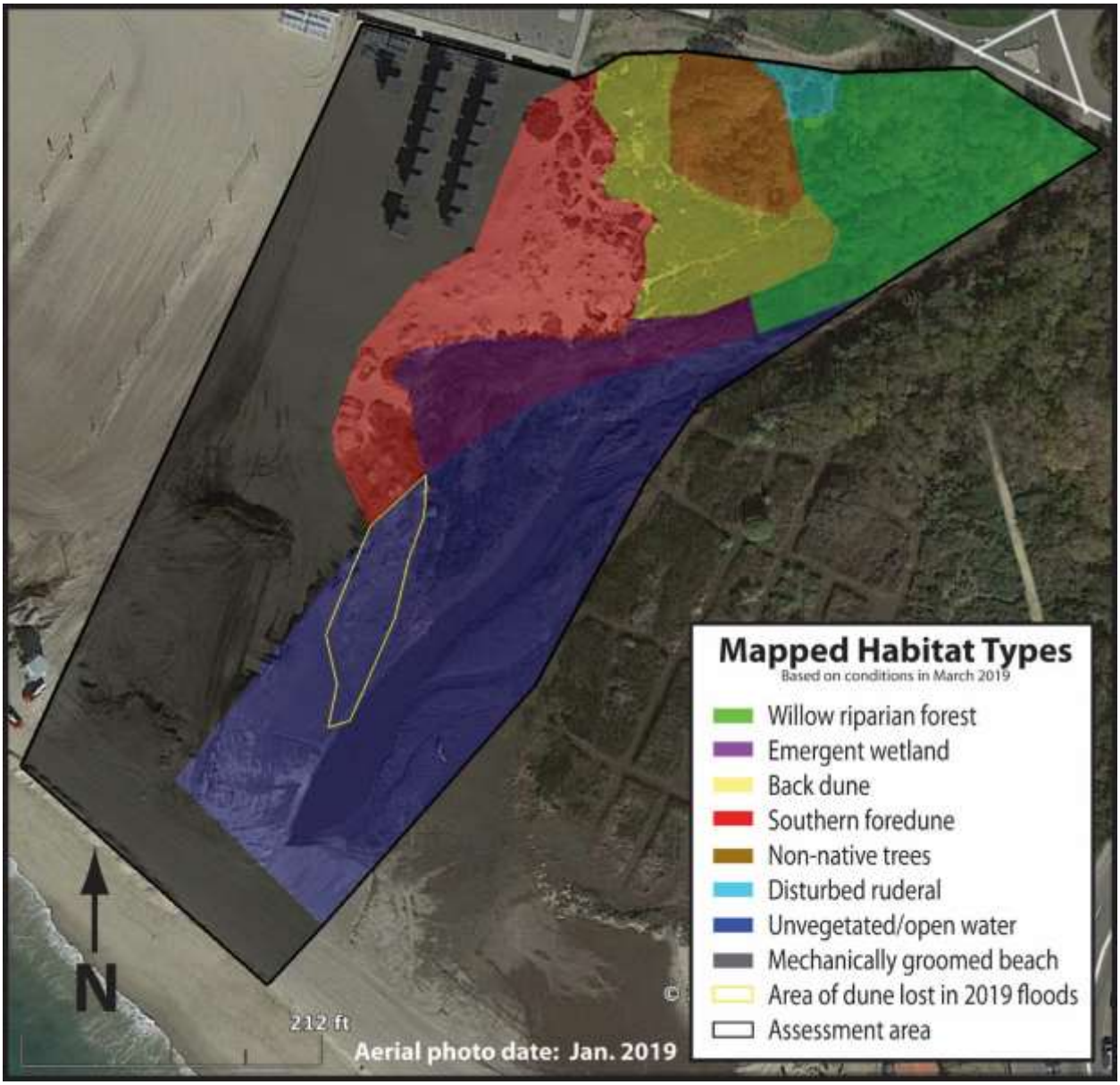

Figure 16. Habitat mapping of project area at Zuma Lagoon. Flooding between the date of the aerial photo (January 2019) and the date of the assessment (March 2019) removed both southern foredune and emergent wetland vegetation. Mapping includes the restoration area and adjacent habitats.

Table 1. Approximate area of each habitat type (acres) mapped in March 2019.

Habitat Type	Acreage	Portion included in Restoration Plan
Willow Riparian Forest	0.50	None
Emergent Wetland	0.25	None
Back Dune	0.31	All
Southern foredune	0.55	All
Non-native Trees	0.18	All
Disturbed Ruderal	0.03	All
Unvegetated/Open Water	1.38	None
Mechanically Groomed Beach	1.80	Portion, less than 0.10 acres
Total	5.00	Approximately 1.1 acres total

Willow Riparian Forest – This habitat type covered about 0.50 acres along Zuma Creek outside of the restoration area (Figure 16). This is a freshwater habitat and its seaward distribution is likely limited by higher water and soil salinities closer to the ocean. This habitat is dominated by arroyo willow (*Salix lasiolepis*). It might typically have an understory of native and non-native shrubs and forbs, however recent flooding seems to have eroded these and left bare soil. High water levels at the time of the assessment may have precluded identification of understory species that were submerged or buried under fresh sediment deposits.

Emergent Wetland – This habitat type covered about 0.25 acres along Zuma Creek and along the margins of Zuma Lagoon outside of the restoration area. This is a brackish water habitat that tolerates both seasonal flooding and drought with a wide range of salinities. This habitat is dominated by California tule (*Schoenoplectus californicus*), significant areas of which had been recently scoured out by flooding. Underground rhizomes may have survived the flooding and these areas may convert from bare ground or open water back to emergent wetland rapidly. A few individual tamarisks (*Tamarix* sp.), invasive non-native trees, are found in this habitat type.

Back Dune – This habitat type covered about 0.31 acres north of the lagoon and is all within the restoration area. Back dunes occur on sandy soils that are sufficiently stabilized (i.e., little or no blowing sand) due to their position in the lee of foredunes. The lack of sand movement leads to a buildup of nutrients and inclusion of some fines (i.e., silt, clay or organic components) in the soil. The habitat is currently dominated by the invasive non-native iceplant (*Carpobrotus* spp.) with other non-natives such as Bermuda grass (*Cynodon dactylon*), carnation spurge (*Euphorbia terracina*), and various non-native annual grasses (*Bromus* and *Hordeum* spp.). However, this soil structure could allow for a wide range of forbs and shrubs native species not found in foredunes, including California poppy (*Eschscholzia californica*), seacliff buckwheat (*Eriogonum parvifolium*), beach evening primrose (*Camissoniopsis cheiranthifolia*), coast goldenbush (*Isocoma menziesii*), and pink sand verbena (*Abronia umbellata*). Eradication of the non-native plants will be important for allowing re-establishment of native back dune habitats via seeding and planting.

Southern Foredune – This habitat type covered about 0.55 acres north of the lagoon and is all within the restoration area. Southern foredune habitats occur on fine to coarse sand that is subject to aeolian processes. The native species that are specially adapted to this harsh environment include red sand verbena (*Abronia maritima*), beach bur (*Ambrosia chamissonis*), and beach saltbush (*Atriplex leucophylla*), which in natural systems typically achieve total cover of 20-35%. All of these species are adapted to repeatedly being buried by blowing sand and then growing taller. This process leads to the

building of dune topography. The southern foredunes in the assessment area are currently dominated by patchy beach bur and beach evening primrose. Non-natives present include Bermuda grass, European sea rocket, and iceplant. Restoration actions should include removal of these non-natives and planting and/or seeding of native plants along with structural support for dune formation such as sand fencing or biomimicry stakes. Areas of this habitat immediately adjacent to the lagoon that are not protected by dense emergent wetland habitats are subject to being eroded out during floods, as happened in 2019 when about 0.13 acres were washed out.

Non-native Trees – Non-native trees covered about 0.18 acres north of Zuma Creek. Some of the trees, including Ngaio tree (*Myoporum laetum*), are aggressive invaders of coastal habitats and probably established on their own, while others, such as a pine tree (*Pinus* sp.) may have been planted. Removal of the Ngaio trees is included in the restoration planning and will allow for transition between dune and riparian habitats.

Disturbed Ruderal – A small area (about 0.03 acres) north of the lagoon appears to be regularly disturbed by driving and supports Bermuda grass and various non-native herbs. This habitat is included in the restoration area. Without regular disturbance and with removal of the non-natives this area could support restoration of native riparian forest or shrublands.

Unvegetated/Open Water – This habitat type covered about 1.38 acres within the lagoon and is outside the restoration area. The proportion of open water to unvegetated flats depends on water levels in the lagoon and time since major flooding. This habitat type will change over time with rainfall and groundwater conditions. Habitats like emergent wetlands would be expected to re-colonize some of the bare soil areas in between flood events.

Mechanically Groomed Beach – Groomed beach covered about 1.80 acres within the assessment area and large areas north and south of the lagoon. A small portion of this area is included in the restoration plan (just under a tenth of an acre). Groomed beach has very limited habitat value and essentially no vegetation. Removal of grooming followed by seeding of species such as beach bur, red sand verbena, beach evening primrose, and beach saltbush would allow southern foredune habitat to re-establish in these areas. Re-establishment of vegetation would lead to increased sand storage and topography. The long-term benefits of dune building are of interest to those concerned with employing soft approaches to sea level rise resilience. Lifeguard towers are currently stored in an approximately quarter acre section of this area during the winter.

Transition Habitats – Though not mapped, it is important to understand that transition zones occur between each of these habitats. Transition zones typically have growing conditions intermediate to those found in adjacent habitats and might support a mix of species from both of the adjacent habitats or unique species. Important transition zones that currently occur and that will be important to consider during restoration include wetland-upland transitions, the foredune-back dune transition, and the riparian-back dune transition.

Western Snowy Plovers and California Least Terns

Western snowy plovers (*Charadrius alexandrinus nivosus*), a federally threatened species of bird, are known to inhabit roosting sites around Zuma Beach. Snowy plovers typically forage for small invertebrates in wet or dry beach-sand, among tide-cast kelp, and within low foredune vegetation. Individuals show high site fidelity and have been observed returning to Los Angeles County to the same

beach for as many as six years (Ryan and Vigallon 2010). Highest population roost counts generally occur between August and March.

Beach grooming is one of the key impacts to plovers both directly through mortality and indirectly through habitat restrictions (Ryan et al. 2017). This beach and the roosting area are within Western Snowy Plover Critical Habitat Subunit CA-43 (USFWS 2012). It extends about 3 mi (5 km) north along the coast from the north side of Point Dume to the base of Trancas Canyon. Threats for this subunit include sea level rise, non-native invasive species, and intensive human use of the area, among others. “Physical or biological features” essential to the conservation of the species are identified (in part) as dune-backed beaches, sparsely vegetated dunes, and beaches at creek and river mouths (USFWS 2012).

However, the Zuma Beach plover roost site is northwest from the proposed restoration area by approximately 1,300 meters. Figure 17, replicated from Ryan et al. 2017, identifies plover roosting locations from 2012-2017, showing a high site fidelity. Plovers have not been previously identified within the restoration project footprint area (T. Ryan and S. Vigallon, pers. comm, 29 April 2020).

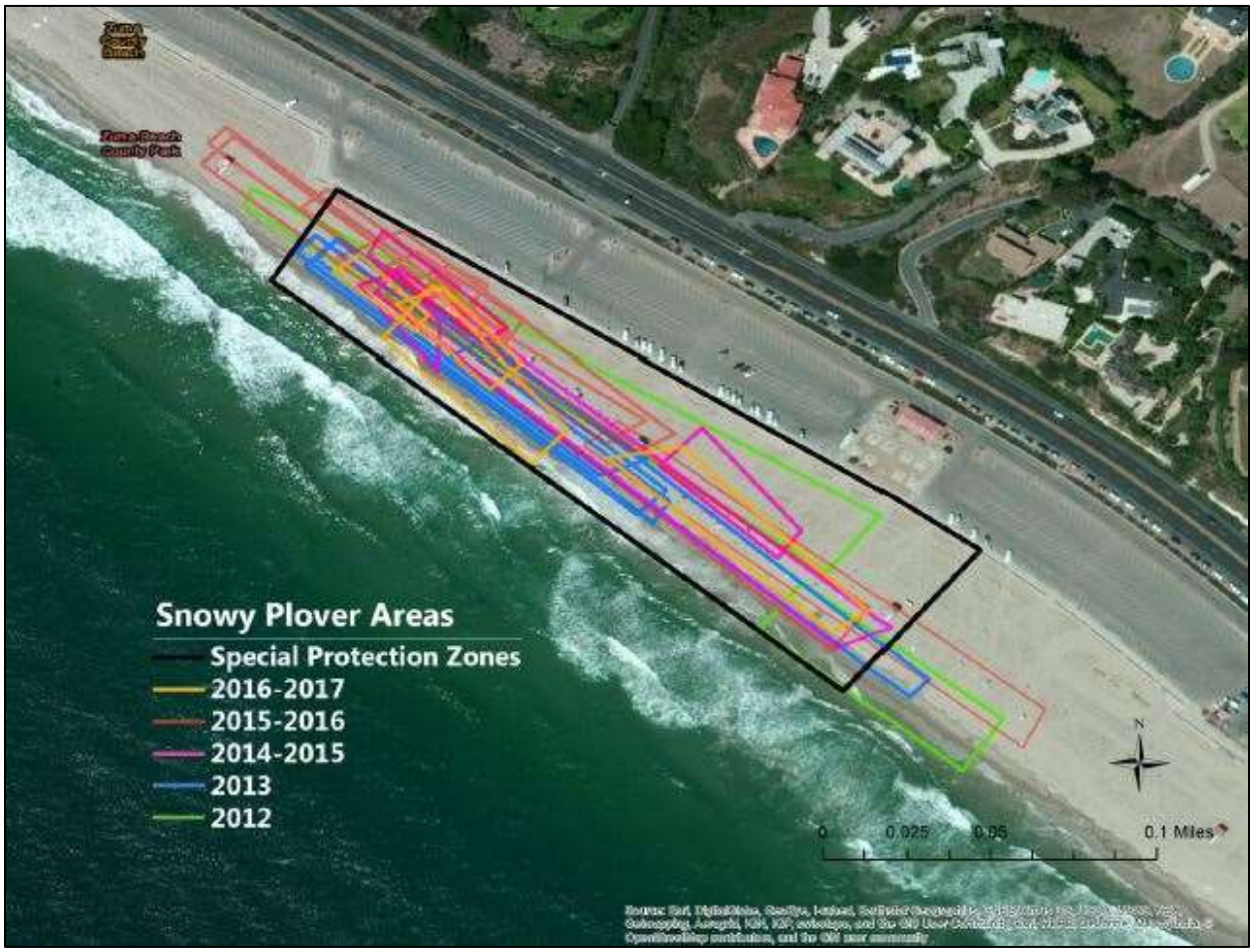

Figure 17. Roosting plover areas at Zuma Beach northwest of the restoration project area.

Roosting plovers at Zuma Beach saw a 50% decline between 2014 and 2017 (Ryan et al. 2017). Zuma Beach was previously the largest roost and supported 41% of the LA County population from 2004-2009 (Ryan et al. 2010), but 29% from 2004-2017 (Ryan et al. 2017). However, between 2014-2016, it

supported only 16% of the LA County population, reaching its lowest point in 2015-16, with just 7% (Ryan et al. 2017). 2018 and 2019 saw the return of roosting plovers at Zuma Beach, with total annual counts of 289 and 153, respectively (Ryan 2019a and 2019b). Table 2 summarizes the total count by year for roosting western snowy plovers. Most recently, in March 2020, approximately 40 plovers were utilizing the Zuma Beach roosting site (T. Ryan pers. comm.).

Table 2. Western snowy plovers roosting at Zuma Beach by year.

YEAR	COUNT		YEAR	COUNT
2004	130		2012	85
2005	133		2013	80
2006	213		2014	73
2007	52		2015	0
2008	32		2016	10
2009	82		2017	46
2010	80		2018	289
2011	86		2019	153

Figure 18. Photograph of Western Snowy Plover outside of restoration area within the roosting site to the northwest (credit: Grace Murayama, Audubon Society).

California least terns (*Sternula antillarum browni*), a federally endangered species of bird, have a distinctive black cap with black stripes running from the cap across the eyes to the beak. They are the smallest North American tern. Their food is primarily small fishes, but also shrimp and occasionally other invertebrates (USFWS website, accessed May 2020).

The 5-year review of the CA least tern recovery plan (USFWS 2006) includes the closest known least tern colony areas to the south of the project location in Coastal Management Area G in Los Angeles at Venice Beach and Playa del Rey Beach. The closest sites to the north are in Coastal Management Area F at Ormond Beach and Mugu Lagoon. Least terns are not known to use the restoration area and have not been identified in repeated Audubon Society surveys from 2010-2020 (Ryan 2019a and 2019b).

Tidewater Gobies and Southern California Coast Steelhead Trout

Tidewater gobies (*Eucyclogobius newberryi*), a federally endangered species of fish, can be found in small coastal lagoons that experience intermittent openings to the ocean. The lagoons, estuaries, backwater marshes, and tributaries that tidewater goby occupy are dynamic environments subject to considerable fluctuations on a seasonal and annual basis (USFWS 2013). Zuma Lagoon (project adjacent) is identified as Critical Habitat by US Fish and Wildlife Service, though there are no current populations in the lagoon. Surveys conducted by biologists with Resource Conservation District of Santa Monica Mountains have not identified tidewater gobies as present in any survey since 2005, though surveys have been conducted at least annually, and usually in the fall (R. Dagit, pers. comm., 1 May 2020; Dagit et al. 2018; Dagit 2018).

The "specific physical or biological features" essential to tidewater goby conservation include saline aquatic habitats such as lagoons, estuaries, and backwater marshes (USFWS 2013). Thus, the restoration is unlikely to affect the potential for tidewater gobies to populate the site, as wetland and aquatic habitat restoration is not a component of this restoration plan. Similarly, the restoration project will not alter the sandbar in front of the mouth of the lagoon. However, the Federal Register (Vol. 78, No. 25) identifies sea level rise as a threat to the species, so there may be indirect benefits through habitat preservation in the form of increased coastal resiliency.

The local Southern California coast steelhead trout (*Oncorhynchus mykiss*) is a federally endangered distinct population segment of a species of trout, including naturally spawned anadromous steelhead. Freshwater-resident (non-anadromous) *O. mykiss*, commonly known as rainbow trout, also occur in the same geographic region, frequently co-occurring in the same river systems as the anadromous form (NOAA 2016). Arroyo Sequit, Malibu, and Topanga Creeks are the closest known "core" population segments of *O. mykiss* (NOAA 2016). Surveys conducted by biologists with Resource Conservation District of Santa Monica Mountains have not identified steelhead trout as present in any survey since 2005, though surveys have been conducted at least annually, and usually in the fall (R. Dagit, pers. comm., 1 May 2020; Dagit et al. 2018; Dagit 2018).

Additional Wildlife and Plants

A list of additional wildlife and plants with special status listing is prepared as Appendix 2. Data were downloaded from the California Natural Diversity Database (CNDDB) hosted by California Department of Fish and Wildlife on 10 April 2020 for the Zuma Quad and a 9-quad search centered on Zuma Quad (https://wildlife.ca.gov/Data/CNDDB). The goal of the CNDDB is to provide the most current information available on the state's most imperiled elements of natural diversity and to provide tools to analyze these data. While no listed or special status species have been identified in the project area to date, see Appendix 2 and also "Conservation Measures" in the Implementation and Monitoring Plan for additional avoidance protocol details such as pre-restoration bird and wildlife surveys. The full single-quad for Zuma list contains two amphibians, 14 birds, one bryophyte, one fish, five insects, five mammals, six reptiles, 23 plants, and one plant community. The full 9-quad search identified four amphibians, one arachnid, 35 birds, three fish, seven insects, 10 mammals, one mollusk, 10 reptiles, one bryophyte, 54 plants, and nine plant communities. The 9-quad search list is available upon request to TBF. Appendix 2 contains the Zuma Quad list, project site notes, and recommended conservation measures.

Figure 19. Photograph of Point Dume Beach restoration area taken on 11 January 2020.

4) OPPORTUNITIES AND CONSTRAINTS

The analyses of the historical ecology and the current biological conditions of the site provide a basis for developing a restoration strategy for the project area. While it may be tempting to simply propose restoring the site to its pre-disturbance condition, this is unrealistic in this setting given the anthropogenic changes over time. However, there are important opportunities for restoring more natural ecosystem functioning within the constraints put on the project by development and human use, especially those ecosystem services that maximize the potential of the site to be resilient to sea level rise and coastal storm erosion. Identification of these opportunities and constraints allows for the development of a realistic project that maximizes ecological and other benefits while working within the real-world constraints of the site.

Restoration Opportunities:

- Existing dune plant distribution and dune topography provide a basis for restoring more natural vegetation and topography throughout more of the site; the existing dunes in some areas, once restored, will help expedite dune growth
- Native plants can be retained and left in place, supporting the native seed bank and increasing vegetation cover over time
- The beach does not appear to be sand-starved, suggesting there will be sufficient sand available for dune-building processes
- The large project area will allow extensive restoration with consolidation of paths through the dunes to minimize impacts
- Restored dunes could reduce sand blowing onto parking lot and decrease maintenance needs
- Sand that blows onto the parking lot from un-restored areas can be beneficially placed back on the seaward side of the parking lot to build dunes; may be most beneficial at north end of beach
- Restored dunes will make the site more resilient to the effects of sea level rise and protect infrastructure
- Opportunity for public engagement and awareness through interpretive signage and pathways

Restoration Constraints:

- Need to maintain parking and other infrastructure in their current configurations
- Need to maintain beach access through the dunes for people and vehicles
- Flat unvegetated towel space needs to be preserved in areas that would otherwise support foredune and dune habitat
- Beach grooming removes wrack, which would otherwise provide important ecosystem and biogeochemical functions to the beach and dune system; but beach grooming practices need to be maintained in project-adjacent areas
- The narrow beach at north end of Point Dume Beach is steep and there is limited up-wind dry sand most of the year to naturally re-build dunes
- Zuma Lagoon is dynamic and restoration area may be subject to flooding and erosion cycles if proposed too close to the lagoon system
- The beach around Zuma Lagoon is highly managed and currently used for winter storage of lifeguard towers, volleyball, filming and other events, etc.

5) CONCLUSIONS

Based on the historical ecology and site assessment data results, a restoration plan was written for both Zuma Beach and Point Dume Beach. Details on restoration activities, scientific monitoring requirements, and recommended success criteria can be found in the Malibu Living Shoreline Project: Implementation and Monitoring Plan (Johnston et al. 2020). Though both locations have some dunes already present, removal of invasive vegetation will allow for the seeding and planting of native species which are well adapted to dune formation. Both sites have areas that are largely dominated by invasive iceplant, which will need to be removed. However, the existing dune topography will allow for quicker formation of naturally functioning dunes than the areas that have been mechanically maintained. The inclusion of interpretive signage and pathways will allow the millions of annual visitors to the area a chance to interact with and enjoy the restored areas in a responsible manner.

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APPENDIX 1: PLANT SPECIES LISTS POINT DUME BEACH & ZUMA BEACH SITES

Native Plants	Common name	Point Dume	Zuma Beach
Abronia umbellata	Pink sand verbena	*	
Abronia maritima	Red sand verbena		*
Ambrosia chamissonis	Beach bur	*	*
Calystegia soldanella	Beach morning-glory	*	
C*amissoniopsis cheiranthifolia*	Beach evening primrose	*	*
Distichlis spicata	Saltgrass	*	
Eschscholzia californica	California poppy (coastal)	*	
Atriplex leucophylla	Beach saltbush	was not observed in project area	
Riparian and wetland plants			
Salix lasiolepis	Arroyo willow		*
Schoenoplectus californicus	California bulrush		*
Typha sp.	hybrid cattail		*
Backdune/bluff scrub plants			
Artemisia californica	California sagebrush	*	
Artemisia douglasiana	Mugwort	*	
Atriplex lentiformis	Big saltbush	*	
Baccharis pilularis	Coyote brush	*	*
Calystegia macrostegia	Coast morning glory	*	
Encelia californica	California sunflower	*	
Ericameria ericoides	Mock heather	*	
Eriogonum parvifolium	Seacliff buckwheat		*planted in rest. area
Croton californicus	California croton	*	
Leptosyne (Coreopsis) gigantea	Giant coreopsis	*	
Malosma laurina	Laurel sumac	*	
Mirabilis laevis	California four o'clock	*	
Rhus integrifolia	Lemonadeberry	*	
Peritoma (Isomeris) arborea	Coast bladderpod	*	

Non-Native Plants	Common name	Point Dume	Zuma Beach
Bromus diandrus	Ripgut brome	*	*
Cakile maritima	Sea rocket	*	*
Carpobrotus edulis	Iceplant	*	*
Cortaderia selloana	Pampas grass		*
Cynodon dactylon	Bermuda grass	*	*
Delairea odorata	Cape Ivy		*
Euphorbia terracina	Carnation spurge	*	*
Hordeum murinum	barley		*
Mesembryanthemum crystallinum	Crystalline iceplant	*	
Myoporum laetum	Ngaio tree	*	*
Pinus sp.	Pine tree		*
Raphanus sativa	Wild radish		*
Tamarix sp.	Tamarisk		*

Appendix 2: CNDDB list for Zuma Quad with additional observation notes and conservation measures.

Category	Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank	Project Site Notes	Conservation Measures
Amphibians	*Rana draytonii*	California red-legged frog	Threatened	None	SSC	N/A	No wetland habitat in project area; unlikely to occur	Pre-restoration wildlife survey
Amphibians	*Taricha torosa*	Coast Range newt	None	None	SSC	N/A	No wetland habitat in project area; unlikely to occur	Pre-restoration wildlife survey
Birds	*Accipiter cooperii*	Cooper's hawk	None	None	WL	N/A	Known to be adjacent to project area; possible foraging within project area	Pre-restoration bird survey
Birds	*Aquila chrysaetos*	golden eagle	None	None	FP; WL	N/A	Unlikely to occur in project area	Pre-restoration bird survey
Birds	*Synthliboramphus scrippsi*	Scripps's murrelet	Candidate	Threatened	-	N/A	Unlikely to occur in project area	Pre-restoration bird survey
Birds	*Ardea herodias*	great blue heron	None	None	-	N/A	Known to be adjacent to project area; possible foraging within project area	Pre-restoration bird survey
Birds	*Charadrius alexandrinus nivosus*	western snowy plover	Threatened	None	SSC	N/A	Known to be adjacent to project area (>1,300 m); possible foraging within project area	Pre-restoration bird survey
Birds	*Gavia immer*	common loon	None	None	SSC	N/A	Known to be adjacent to project area	Pre-restoration bird survey
Birds	*Riparia riparia*	bank swallow	None	Threatened	-	N/A	Unlikely to occur in project area	Pre-restoration bird survey
Birds	*Agelaius tricolor*	tricolored blackbird	None	Threatened	SSC	N/A	Unlikely to occur in project area	Pre-restoration bird survey
Birds	*Hydroprogne caspia*	Caspian tern	None	None	-	N/A	Known to be adjacent to project area; possible foraging within project area	Pre-restoration bird survey

Category	Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank	Project Site Notes	Conservation Measures
Birds	*Larus californicus*	California gull	None	None	WL	N/A	Known to be adjacent to project area; possible foraging within project area	Pre-restoration bird survey
Birds	*Baeolophus inornatus*	oak titmouse	None	None	-	N/A	Unlikely to occur in project area	Pre-restoration bird survey
Birds	*Setophaga petechia*	yellow warbler	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration bird survey
Birds	*Pelecanus occidentalis californicus*	California brown pelican	Delisted	Delisted	FP	N/A	Known to be adjacent to project area	Pre-restoration bird survey
Birds	*Phalacrocorax auritus*	double-crested cormorant	None	None	WL	N/A	Known to be adjacent to project area	Pre-restoration bird survey
Fish	*Eucyclogobius newberryi*	tidewater goby	Endangered	None	SSC	N/A	No wetland or lagoon habitat in project area; unlikely to occur	No measures needed because outside project area
Insects	*Trimerotropis occidentiloides*	Santa Monica grasshopper	None	None	-	N/A	Unlikely to occur in project area	Careful hand removal of invasive vegetation
Insects	*Bombus crotchii*	Crotch bumble bee	None	Candidate Endangered	-	N/A	Identified in riparian area southeast of project area	Careful hand removal of invasive vegetation
Insects	*Atractelmis wawona*	Wawona riffle beetle	None	None	-	N/A	Unlikely to occur in project area	Careful hand removal of invasive vegetation
Insects	*Danaus plexippus pop. 1*	monarch - California overwintering population	None	None	-	N/A	Identified adjacent to project area	Pre-restoration wildlife survey
Insects	*Euphydryas editha quino*	quino checkerspot butterfly	Endangered	None	-	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Mammals	*Eumops perotis californicus*	western mastiff bat	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey

Category	Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank	Project Site Notes	Conservation Measures
Mammals	*Taxidea taxus*	American badger	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Mammals	*Lasiurus blossevillii*	western red bat	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Mammals	*Lasiurus cinereus*	hoary bat	None	None	-	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Mammals	*Myotis yumanensis*	Yuma myotis	None	None	-	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Reptiles	*Anniella stebbinsi*	California legless lizard	None	None	SSC	N/A	Closest reported observation is the Point Dume bluff above and east of the project area	Pre-restoration wildlife survey
Reptiles	*Diadophis punctatus modestus*	San Bernardino ringneck snake	None	None	-	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Reptiles	*Emys marmorata*	western pond turtle	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Reptiles	*Thamnophis hammondii*	two-striped gartersnake	None	None	SSC	N/A	Identified adjacent to project area	Pre-restoration wildlife survey
Reptiles	*Phrynosoma blainvillii*	coast horned lizard	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Reptiles	*Aspidoscelis tigris stejnegeri*	coastal whiptail	None	None	SSC	N/A	Unlikely to occur in project area	Pre-restoration wildlife survey
Community	*Southern Sycamore Alder Riparian Woodland*	Southern Sycamore Alder Riparian Woodland	None	None	-	N/A	Not identified within project area	No measures needed
Bryophytes	*Tortula californica*	California screw moss	None	None	-	1B.2	Not identified within project area	Pre-restoration plant survey
Plants	*Baccharis malibuensis*	Malibu baccharis	None	None	-	1B.1	Not identified within project area	Pre-restoration plant survey

Category	Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank	Project Site Notes	Conservation Measures
Plants	*Deinandra minthornii*	Santa Susana tarplant	None	Rare	-	1B.2	Not identified within project area	Pre-restoration plant survey
Plants	*Pentachaeta lyonii*	Lyon's pentachaeta	Endangered	Endangered	-	1B.1	Not identified within project area, but one identification northeast of project area in Zuma Canyon	Pre-restoration plant survey
Plants	*Atriplex coulteri*	Coulter's saltbush	None	None	-	1B.2	Not identified within project area	Pre-restoration plant survey
Plants	*Dudleya blochmaniae ssp. blochmaniae*	Blochman's dudleya	None	None	-	1B.1	Not identified within project area	Pre-restoration plant survey
Plants	*Dudleya cymosa ssp. agourensis*	Agoura Hills dudleya	Threatened	None	-	1B.2	Not identified within project area, closest identification in Point Dume bluff area	Pre-restoration plant survey
Plants	*Dudleya cymosa ssp. marcescens*	marcescent dudleya	Threatened	Rare	-	1B.2	Not identified within project area	Pre-restoration plant survey
Plants	*Astragalus brauntonii*	Braunton's milk-vetch	Endangered	None	-	1B.1	Not identified within project area, thought to be in bluffs above Dume Cove east of project area	Pre-restoration plant survey
Plants	*Quercus dumosa*	Nuttall's scrub oak	None	None	-	1B.1	Not identified within project area	Pre-restoration plant survey
Plants	*Juglans californica*	southern California black walnut	None	None	-	4.2	Not identified within project area	Pre-restoration plant survey
Plants	*Lepechinia fragrans*	fragrant pitcher sage	None	None	-	4.2	Not identified within project area	Pre-restoration plant survey
Plants	*Calochortus catalinae*	Catalina mariposa-lily	None	None	-	4.2	Not identified within project area	Pre-restoration plant survey

Category	Scientific Name	Common Name	Federal Status	State Status	CDFW Status	CA Rare Plant Rank	Project Site Notes	Conservation Measures
Plants	*Calochortus clavatus var. gracilis*	slender mariposa-lily	None	None	-	1B.2	Not identified within project area	Pre-restoration plant survey
Plants	*Calochortus plummerae*	Plummer's mariposa-lily	None	None	-	4.2	Not identified within project area, but possibly adjacent	Pre-restoration plant survey
Plants	*Lilium humboldtii ssp. humboldtii*	Humboldt lily	None	None	-	4.2	Not identified within project area	Pre-restoration plant survey
Plants	*Calandrinia breweri*	Brewer's calandrinia	None	None	-	4.2	Not identified within project area	Pre-restoration plant survey
Plants	*Camissoniopsis lewisii*	Lewis' evening-primrose	None	None	-	3	Not identified within project area	Pre-restoration plant survey
Plants	*Navarretia ojaiensis*	Ojai navarretia	None	None	-	1B.1	Not identified within project area	Pre-restoration plant survey
Plants	*Chorizanthe parryi var. parryi*	Parry's spineflower	None	None	-	1B.1	Not identified within project area	Pre-restoration plant survey
Plants	*Eriogonum crocatum*	conejo buckwheat	None	Rare	-	1B.2	Not identified within project area	Pre-restoration plant survey
Plants	*Cercocarpus betuloides var. blancheae*	island mountain-mahogany	None	None	-	4.3	Not identified within project area	Pre-restoration plant survey
Plants	*Horkelia cuneata var. puberula*	mesa horkelia	None	None	-	1B.1	Not identified within project area	Pre-restoration plant survey
Plants	*Thelypteris puberula var. sonorensis*	Sonoran maiden fern	None	None	-	2B.2	Not identified within project area	Pre-restoration plant survey