# COUNTY OF LOS ANGELES
# DEPARTMENT OF BEACHES & HARBORS
# COASTAL RESILIENCE STUDY

## FINAL REPORT

Produced For County of Los Angeles Department of Beaches & Harbors
Date December 22, 2023

# Document Verification

| | |
|---|---|
| **Client** | County of Los Angeles Department of Beaches and Harbors (LACDBH) |
| **Project name** | Coastal Resilience Study |
| **Document title** | Report |
| **Document sub-title** | – |
| **Status** | Final Report |
| **Date** | December 22, 2023 |
| **Project number** | 211193/03, Task 5.1 |
| **File reference** | Coastal Resiliency Study (Final Report).docx |

| Revision | Description | Issued by | Date | Checked |
|---|---|---|---|---|
| 00 | Draft Report | CW | 11/17/23 | VC, CW |
| 01 | Final Report | VC | 12/22/23 | VC, CW |
| | | | | |
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**Produced by:**

moffatt & nichol

Moffatt & Nichol

4225 E. Conant St

Long Beach, CA 90808

www.moffattnichol.com

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**Attachment A1**—Preliminary Draft Order of Magnitude Opinion of Probable Construction Costs for the Zuma/Pt. Dume Nourishment and Living Shoreline Concept

**Attachment A2**—Preliminary Draft Order of Magnitude Opinion of Probable Construction Costs for the Dockweiler Project Concept

**Attachment A3**—Preliminary Draft Order of Magnitude Opinion of Probable Construction Costs for the South Redondo Beach Project Concept

**Attachment B1**—Preliminary Engineering Design Plans and Cross-Sections For The Project Concept at Zuma/Point Dume Beach

**Attachment B2**—Preliminary Engineering Design Plans and Cross-Sections for the Project Concept at South Redondo Beach

**Attachment C**—Economic Study by Ceto

# 1. Executive Summary

County of Los Angeles Department of Beaches and Harbors (LACDBH) developed the Coastal Resilience Study to understand the future changes anticipated along the shoreline by building upon previous regional risk and vulnerability assessments developed by LACDBH, US Army Corps of Engineers, and other agencies to provide detailed risk assessments of its 18 public beaches. The Coastal Resilience Study evaluates risks, details adaptation strategies, and prioritizes projects based upon forecasted coastal erosion and sea level rise coupled with project co-benefits and appropriate shoreline protection measures to preserve and enhance LA County beaches, including infrastructure and facilities, recreational open space, natural and cultural resources, and habitat for sensitive species. The study also focuses on several prototype sites to demonstrate how the latest techniques can be implemented to provide shoreline access as sea levels rise and erosion occurs. By working with a wide range of experts, the team has developed an integrated approach to adaptation planning and design that will benefit the community and the broader region for decades to come.

The Coastal Resilience Study concluded the following:

1. Beaches are eroding over long reaches and large areas, mostly occurring in the northern portion of LA County. The cause of erosion is reduction in historic sediment supply from upcoast and watersheds.
2. Collaborating and partnerships will be instrumental to design appropriate adaptation projects and secure funding for implementation.
3. Potential solutions that could benefit LA County may include:
   a) Increasing resilience at Zuma/Point Dume Beach through sand nourishment and establishing living shorelines.
   b) Installing a relatively low barrier wall along the bicycle path at Dockweiler State Beach's western edge to block wind-blown sand from moving directly onto the path and parking lot which also placing sand collection fencing to encourage sand deposition at the dunes seaward of the bike/pedestrian path and parking lot.
   c) Sand nourishing at Redondo Beach to widen the beach, installing an eco-friendly sand retention device at the pier to hold the sand in place, and establishing sand dune habitat.
4. Sand may be able to be inexpensively obtained by establishing a Sand Compatibility and Opportunistic Use Program (SCOUP). The SCOUP would result in surplus sand from upland maintenance or construction projects to be made available at low or no cost to LACDBH for placement at specific permitting beach sites. Sand may also be available from upland sediment detention basins in the foothills and mountains. LACDBH can either include these sand sources in its SCOUP or pursue them separately as individual projects, but the sand should be placed at the beach if it is compatible.
5. LACDBH may wish to develop a sand strategy to plan capture of sufficient sand quantities over time to accomplish coastal resilience. The sand strategy could include active planning and cooperation with other regions (Counties of Santa Barbara and Ventura represented by the Beach Erosion Authority for Clean Oceans and Nourishment or BEACON, County of Orange, San Diego Association of Governments) to create one "super-region" to investigate holistic solutions within the entire Southern California Bight.

# 2. Understanding the Coast

The Southern California Bight[1] (Bight), as shown in Figure 1 below, is a very large embayment bounded by Point Conception to the north and Point La Jolla to the south. The shoreline orientation turns toward the east and runs more northwest to southeast within the Bight along the trend of the mountain ranges, with smaller embayments within the larger Bight. Santa Monica Bay is one of the smaller bays within the Bight; its islands cause approaching waves to refract around the islands and into the Bight. Wave properties change significantly within the Bight and wave energy varies as sheltering occurs by the islands and wave focusing occurs away from the shelters. The Bight encompasses long sandy beaches, however, it is unique in that very large areas also experience erosion and loss of sandy beaches, even though a certain amount of protection from wave energy exists from the islands and the angled orientation of the shoreline.

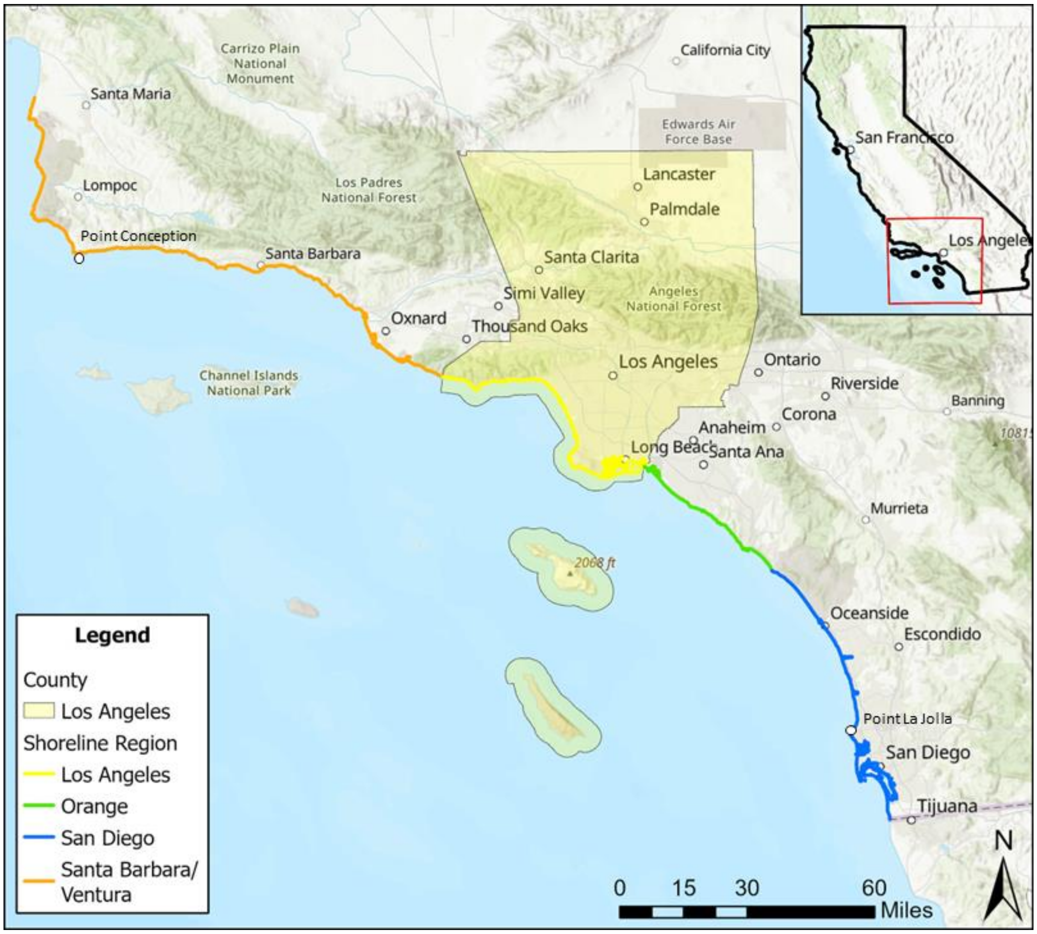


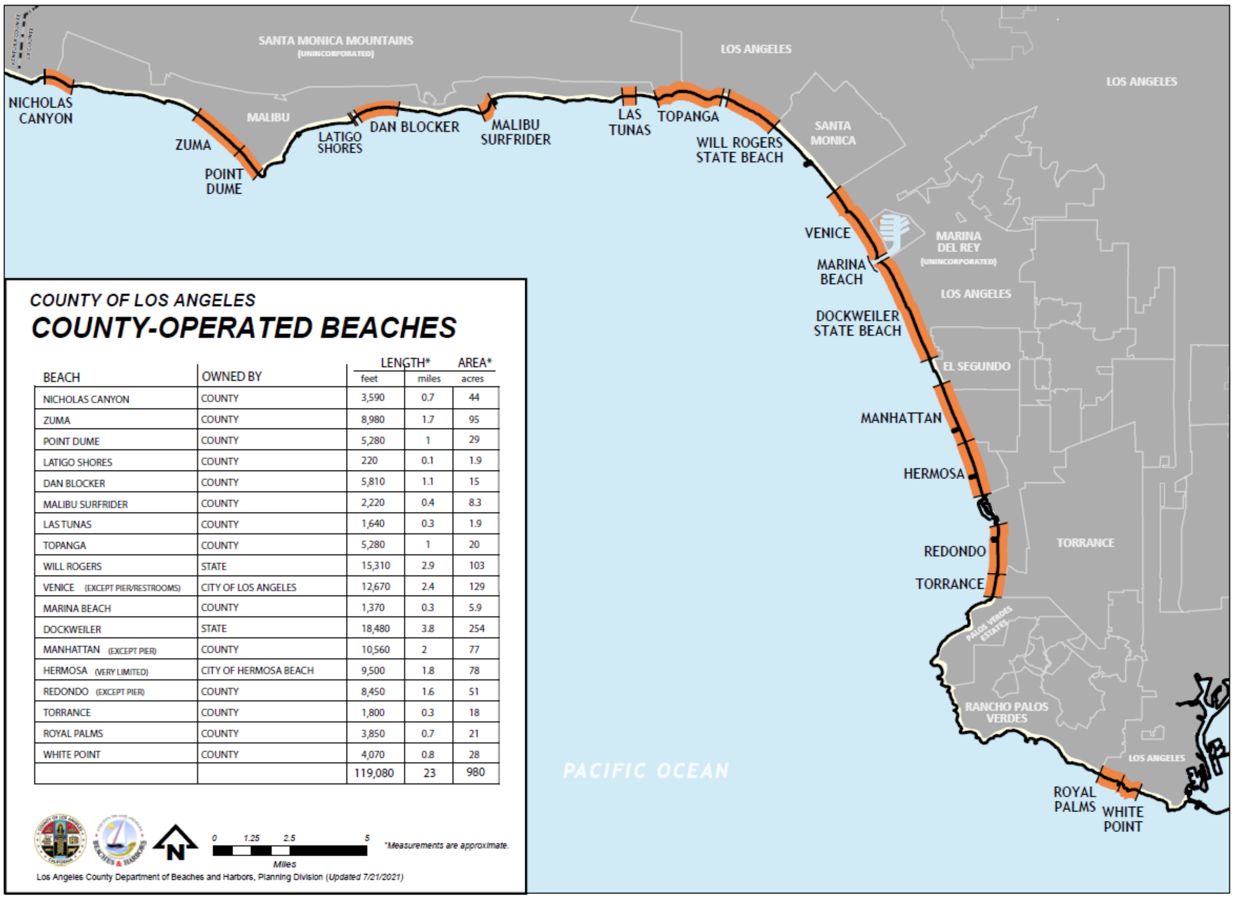

***Figure 1. Southern California Bight***

The coastline of the Bight is separated into four major regions shown in Figure 1. Each region experiences significant problems with coastal erosion due to a shortage of historic sediment supply. Specific reasons for the sand shortages vary within regions, but they all have common problems such as sand trapping at harbors, sand losses to submarine canyons, and damming of major rivers. Historically, each region has independently formed a local group to address its sand shortages and regional sediment management. Santa Barbara/Ventura County's Joint Powers Authority called the Beach Erosion Authority for Clean Oceans and Nourishment (BEACON) is presently working on an update to their regional sediment management approach. Orange County Parks is working on a Strategic Regional Plan to re-

[1] Bight (noun): A bend, as of a coastline; a bay.

build its eroding beaches, and the San Diego Region through the San Diego Association of Governments is working on a third Regional Beach Sand Project that may add south Orange County to its list of participants. However, as part of a larger Southern California regional resilience and adaptation effort, previously siloed agencies are seeing the value in collaboration in an effort to identify and implement holistic solutions to encompass the entire Southern California Bight. With a collaborative approach, agencies and partners can combine resources to find appropriate solutions that can be implemented on a larger scale for greater success across regional boundaries and raise the profile of the region's challenges to State and Federal funding agencies.

In the Southern California Bight, coastal tourism, recreation, and other related industries generate hundreds of millions of dollars annually representing a great source of tourism revenue for both the region and the State. LACDBH operates 18 beaches spanning 23 miles within the Bight (Figure 2) thus making coastal resilience for the region vital as LA County beaches are valuable revenue generators to the region and State at large.




| BEACH | OWNED BY | LENGTH* feet | LENGTH* miles | AREA* acres |
|---|---|---|---|---|
| NICHOLAS CANYON | COUNTY | 3,590 | 0.7 | 44 |
| ZUMA | COUNTY | 8,980 | 1.7 | 95 |
| POINT DUME | COUNTY | 5,280 | 1 | 29 |
| LATIGO SHORES | COUNTY | 220 | 0.1 | 1.9 |
| DAN BLOCKER | COUNTY | 5,810 | 1.1 | 15 |
| MALIBU SURFRIDER | COUNTY | 2,220 | 0.4 | 8.3 |
| LAS TUNAS | COUNTY | 1,640 | 0.3 | 1.9 |
| TOPANGA | COUNTY | 5,280 | 1 | 20 |
| WILL ROGERS | STATE | 15,310 | 2.9 | 103 |
| VENICE (EXCEPT PIER/RESTROOMS) | CITY OF LOS ANGELES | 12,670 | 2.4 | 129 |
| MARINA BEACH | COUNTY | 1,370 | 0.3 | 5.9 |
| DOCKWEILER | STATE | 18,480 | 3.8 | 254 |
| MANHATTAN (EXCEPT PIER) | COUNTY | 10,560 | 2 | 77 |
| HERMOSA (VERY LIMITED) | CITY OF HERMOSA BEACH | 9,500 | 1.8 | 78 |
| REDONDO (EXCEPT PIER) | COUNTY | 8,450 | 1.6 | 51 |
| TORRANCE | COUNTY | 1,800 | 0.3 | 18 |
| ROYAL PALMS | COUNTY | 3,850 | 0.7 | 21 |
| WHITE POINT | COUNTY | 4,070 | 0.8 | 28 |
| | | 119,080 | 23 | 980 |

***Figure 2. Location Of The 18 LA County Beaches***

By identifying risks and implementing adaptation strategies to preserve and enhance coastal resilience and access, LA County positions itself to not only improve revenue streams for future adaptation work, but more importantly to create opportunities to ensure that coastal access will be available for future generations.

# 3. Identifying Risks & Vulnerabilities

LA County beaches are a regional asset that provide critical access to nature, recreation, and educational opportunities. At a high level, the Coastal Resilience Study is focused on balancing goals related to reducing coastal erosion, enhancing climate resiliency, and advancing equitable coastal access. The Study applies a multi-scale approach, from a broader understanding of the regional shoreline to site-specific scale, in characterizing vulnerabilities and providing adaptation guidance. As part of the initial phase of the risk assessment, the overall shoreline analysis summarizes the data gathered to characterize impending coastal hazards to the beaches.

## 3.1. Methodology

Each of the 18 county beaches was assessed using a semi-quantitative method to catalogue the sensitivity indicators listed below for developing final vulnerability scores and adaptation strategies for each beach.

- Existing Beach Conditions
- Future Beach Conditions
- Amenities
- Use

Existing conditions were selected to capture the current vulnerabilities at each beach location as a result of any reduced beach width and erosion. In addition to erosion rates, both average beach width and minimum beach width were included to account for vulnerabilities related to narrow overall beach width and any erosion hot spots along the shoreline. Analysis of all three factors is based on the latest high-resolution coastal LiDAR topography data from 2009 and 2016 (NOAA, 2022). Scores were adjusted as necessary to reflect observed beach conditions not fully captured within the LiDAR datasets, including recent erosion along the roadway at Point Dume. Vulnerability scores for beaches on the Palos Verdes peninsula were also adjusted due to their naturally narrow, rocky condition.

Future conditions we evaluated based the Ocean Protection (OPC) sea level rise (SLR) projection guidelines for the State of California. The 0.50 m (1.6 ft) and 1.0 m (3.3 ft) sea level rise scenarios were selected based on projections for 2050 and 2070, respectively as included in the 2018 OPC SLR Guidance document (California Ocean Protection Council, 2018), identified as the best-available science on state and local sea level rise projections by the California Coastal Commission (California Coastal Commission, 2018). Sea level rise projections (see Table 1) and time horizons are based on a medium-high risk aversion scenario, recommended for use in more vulnerable projects or populations that will experience significant consequences if coastal hazard impacts occur.

***Table 1. Sea Level Projections For Los Angeles County In The Near- And Mid-Term***

| Time Horizon | SLR Projection in Feet (Low Risk Aversion) | SLR Projection in Feet (Medium-High Risk Aversion – Most Applicable to LA County Project Sites) |
|---|---|---|
| **Near-Term (2050-2060)** | 1.1 to 1.4 | 1.9 to 2.6 |
| **Mid-Term (2060-2080)** | 1.4 to 2.3 | 2.6 to 4.4 |

The effects of SLR on future shoreline position were evaluated using results of the Coastal Storm Modeling System (CoSMoS) Version 3.0, Phase 2, a multi-agency effort led by the United States Geological Survey (USGS) to make detailed predictions of coastal flooding and erosion based on existing and future climate scenarios for Southern California (Erikson, et al., 2017). These models were tuned with historic data to account for unresolved sediment transport processes and inputs such as sediment loading from rivers and streams, regional sediment supply including beach nourishment and bypassing, and long-term erosion.

Resources and amenities were collected as a measure of the infrastructure and recreational opportunities present at each beach. If a beach contains a greater number of facilities or recreational resources, it is determined to have a higher level of vulnerability as coastal hazard impacts from erosion could potentially result in greater or more costly losses. All resource and amenity data were collected during field visits to all the beaches and through discussions with LACDBH staff.

Potential vulnerability related to beach use is based on two factors: beach attendance and the social vulnerability of populations in the surrounding areas. For the purposes of this study, a higher number of beach visitors, calculated as the long-term average daily attendance, results in a higher vulnerability score as coastal hazard impacts from erosion could potentially affect a greater number of beachgoers. Beach attendance data was provided by Los Angeles County Fire Department lifeguard staff (Mitre, 2022). Attendance numbers are based on visual estimates from lifeguard staff and are subject to the collector's perspective of the crowd. Parking and accessibility are also accounted in a semi-quantitative manner based on field observations; parking lots were not measured but compared against one-another to assign a score.

Social vulnerability analyses are based on data from the U.S. Centers for Disease Control (CDC) Social Vulnerability Index (SoVI) (Flanagan, et al., 2011). Social vulnerability is defined by the CDC as the potential negative effects on communities caused by external stresses on human health. The CDC SoVI uses 16 socioeconomic and demographic factors at the census tract level to identify socially vulnerable areas where populations may be more adversely impacted during disaster events. These variables are organized around four themes: socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Analyses presented within this study are based on a summary variable that considers each theme, generated through a percentile ranking of all census tracts within the state of California. Social vulnerability and equity will be examined further as part of future work outside of this project, with potential utilization of cell phone data to determine the origin location of beach visitor.

Table 2 outlines the sensitivity categories and indicators that were used to identify vulnerability scores for each beach which would then be used to identify which beach was the most vulnerable.

***Table 2. Sensitivity Indicator Matrix***

| Sensitivity Category | Score | Sensitivity Factors |
|---|---|---|
| Existing Physical Beach Conditions | 50 | Average Beach Width<br>Minimum Beach Width<br>Erosion Rate |
| Future Physical Beach Conditions | 10 | 0.5 m Sea Level Rise<br>1.0 m Sea Level Rise |
| Resources and Amenities | 20 | Restroom Facilities<br>Bike Path<br>Picnic Tables<br>Beach Volleyball Court<br>Pier<br>Snack Bar / Concessions Stand<br>Lifeguard Building<br>Fire Pit<br>Basketball Court<br>Promenade<br>Surf Break<br>Fishing Location<br>Ecological Attraction<br>Maintenance Yard<br>Youth Center<br>Family Friendly Amenities |
| Use | 20 | Average Daily Attendance<br>Parking & Access<br>Social Vulnerability Index |
| **Total** | **100** | |

## 3.2. Access & Equity

Simply put, coastal resiliency and beach preservation are equity issues. For L.A. County, maintaining public access to healthy beaches is a critical racial equity priority, as historic redlining and other racist practices have resulted in gross injustices and created a legacy of inequity in the region's spatial distribution of opportunity. Historically, ethnic minorities have been barred and even forcibly removed from coastal communities, as occurred in the 1920s when the City of Manhattan Beach forced the Bruce Family out of its successful Black-owned beachfront resort. The loss of beaches and public access may result in some areas being inaccessible except for residents of the adjacent and wealthy coastal communities. Without making the beaches more resilient, LACDBH risks losing meaningful public access to some of the most popular and accessible beaches which provide potentially life-saving refuge for our inland disadvantaged communities during extreme heat waves. To eliminate structural racism that has prevented marginalized groups from accessing beaches, LACDBH has incorporated into its resiliency efforts the guiding principles of the County's Anti-Racism, Diversity, and Inclusion (ARDI) initiative, including "prioritizing strategies that effectively support the most disadvantaged groups and peoples." Accordingly, the proposed pilot sites are strategically located based on accessibility by communities of highest need for recreation and open space, and the cultural and economic opportunities that exist along the coastline.

## 3.3. Vulnerability Score

Scores were assigned to each beach for each factor, and results were conveyed as a ranking of each beach based on cumulative scores as seen in Table 3. The top 10 ranked beaches were recommended for consideration as future project sites to increase resilience.

***Table 3. County Top 10 Beach Vulnerability Rankings***

| Beach | Ranking | Total Score |
|---|---|---|
| Zuma | 1 | 79.0 |
| Dockweiler State Beach | 2 | 75.6 |
| Redondo | 3 | 75.3 |
| Malibu Surfrider | 4 | 66.9 |
| Point Dume | 5 | 66.1 |
| Venice | 6 | 65.9 |
| Manhattan | 7 | 64.9 |
| Will Rogers State Beach | 8 | 61.3 |
| Torrance | 9 | 60.8 |
| Dan Blocker | 10 | 59.4 |

Locations north of Will Rogers State Beach generally have the highest vulnerability scores for existing and future beach conditions with SLR due to narrower beach width and higher rates of erosion. Further south, Redondo Beach also scores highly for existing and future vulnerability, especially in comparison to other beaches nearby. Beaches on the Palos Verdes Peninsula generally score lowly due to their naturally narrow and rocky conditions.

Beaches from Will Rogers State Beach to Torrance generally scored the highest in resources and amenities while Zuma to the north also scored high. Dockweiler State Beach ranked the highest in terms of resources and amenities, partially due to its unique fire pits within the region. Venice also scored highly due to its wide variety of resources and recreational opportunities. Both Venice and Dockweiler also rank high rates of attendance, as do Manhattan, Hermosa, and Zuma Beach. The highest scores in the use category are seen where high attendance and access opportunities are combined with high social vulnerability in surrounding areas, such as Zuma Beach, Venice Beach, and Dockweiler State Beach.

## 3.4. Proposed Sites for Adaptation

To further focus on the most critical sites and target solutions with limited County resources, the top 5 beaches on the vulnerability list were carried over into further consideration, and the top 3 were eventually identified for near-term actions. The final three project sites were identified: (1) Zuma and Point Dume as potentially one combined unit for maximum effect, (2) Dockweiler Beach, and (3) South Redondo Beach. Table 4 provides a summary of existing vulnerabilities and proposed solutions for the top three locations of interest.

***Table 4. Summary Of Vulnerabilities And Adaptation Strategies***

| Ranking | Beach | Problem | Adaptation Strategy | Cost |
|---|---|---|---|---|
| 1 and 4 | Zuma and Point Dume | - Highly eroded reach of beach along the access road that connects Zuma to Point Dume Beach,<br>- Constant erosion rate along both Zuma and Point Dume Beaches | - Beach nourishment<br>- Dune habitat as living shoreline | $37,300,000 |
| 5 | Dockweiler | - Excessive wind-blown sand moving onto a public bicycle/pedestrian path and parking lot | - Low barrier wall<br>- Sand fencing<br>- Expanded dune habitat | $2,800,000 |
| 2 | South Redondo | - Narrowing of the beach south of the pier | - Beach nourishment<br>- Eco-friendly sand retention device<br>- Dune habitat as living shoreline | $26,800,000 |

Adaptation strategies can take numerous forms and can be phased over time to plan for erosion and the various sea level rise projections. The strategies described herein are those that are considered likely to have a relatively high probability of success and minimize costs and potential environmental and social impacts while generating revenue. The timeframe for implementation of each of the strategies is near-term, or within the next five to ten years (2030 to 2035) and their lifespans could extend over the next 50 to 55 years (2080).

# 4. Zuma & Point Dume Beach

Zuma Beach and Point Dume are located in Malibu, CA at the norther end of Santa Monica Bay; see Figure 3. Zuma Beach is unique in that it is the widest and longest continuous beach in north LA County, 1.8 miles of beach frontage with 105 acres of property. Combined with Point Dume Beach, it is nearly 2.7 miles long and approximately 233 feet wide, for nearly 75 acres (1 acre is the equivalent of a football field) and serves as a respite for persons living in warmer inland communities.

Zuma Beach has eight parking lots with approximately 2,000 parking spaces. Food stands are located at each end of the beach. Other amenities include restrooms, showers, volleyball nets, and a bus stop. Beach wheelchairs are also available. This beach has become popular for both swimming and body surfing; it continues to be a perennial favorite with residents and visitors alike (LACDBH, 2021). This area experiences a highly eroded reach of beach along the access road that connects Zuma to Point Dume Beach, plus a near constant erosion rate along both Zuma and Point Dume Beaches. Currently the LACDBH erects winter sand dikes at Zuma to prevent flooding of the parking lot and other facilities during storms.


***Figure 3. Zuma And Point Dume Beach Location***

Per the economic study by CETO in Attachment C, official attendance data (2018 to 2022) from Los Angeles County indicates that Zuma beach receives on average of nearly 2 million visitors a year, with 135 days per year exceeding the calculated carrying capacity indicating that this beach is currently too narrow to meet the demand. With just over one-third of all beach days (37%) at Zuma Beach currently over-capacity, reducing beach widths resulting from erosion (3.6 ft per year) will result in Zuma being pushed beyond its carrying capacity. This would result in lost income to the County. When narrowing the period of analysis to just the summer season (June, July, and August), carrying capacity is currently exceeded 90% of the time (82 days), and would increase if the beach is not widened.

## 4.1. Existing Conditions

The existing physical condition of the beach was assessed by calculating the beach width, erosion rate, and berm elevation. The analysis was completed based on the latest high-resolution coastal LiDAR topography data from 2009 and 2016 (NOAA, 2022). The average width was obtained from the 2016 dataset by computing the average distance from the back beach to the mean higher high water (MHHW) line at multiple shore-perpendicular transects that cover the full extent of the shoreline at each beach location. The minimum width was obtained by computing the minimum distance from the back beach to the MHHW line at each transect within a given reach. The erosion rate was computed as the average difference in the MHHW location, measured between 2009 and 2016 at each of the shore-perpendicular profiles, for each beach location. Berm elevation was taken from Los Angeles County Public Beach Facilities Sea-Level Rise Vulnerability Assessment Report (Noble Consultants, 2016). Zuma Beach and Point Dume results are shown in Table 5. Figure 4 and Figure 5 show existing conditions at Zuma and Point Dume Beach, respectively.

***Table 5. Zuma Beach And Point Dune Beach Existing Conditions***

| Beach | Avg Width (ft) | Min Width (ft) | Erosion Rate (ft/yr) | Berm Elevation (ft NAVD88) |
|---|---|---|---|---|
| **Zuma** | 179 | 79 | -3.6 | +10.6 |
| **Point Dume** | 200 | 92 | -1.9 | +12.1 |

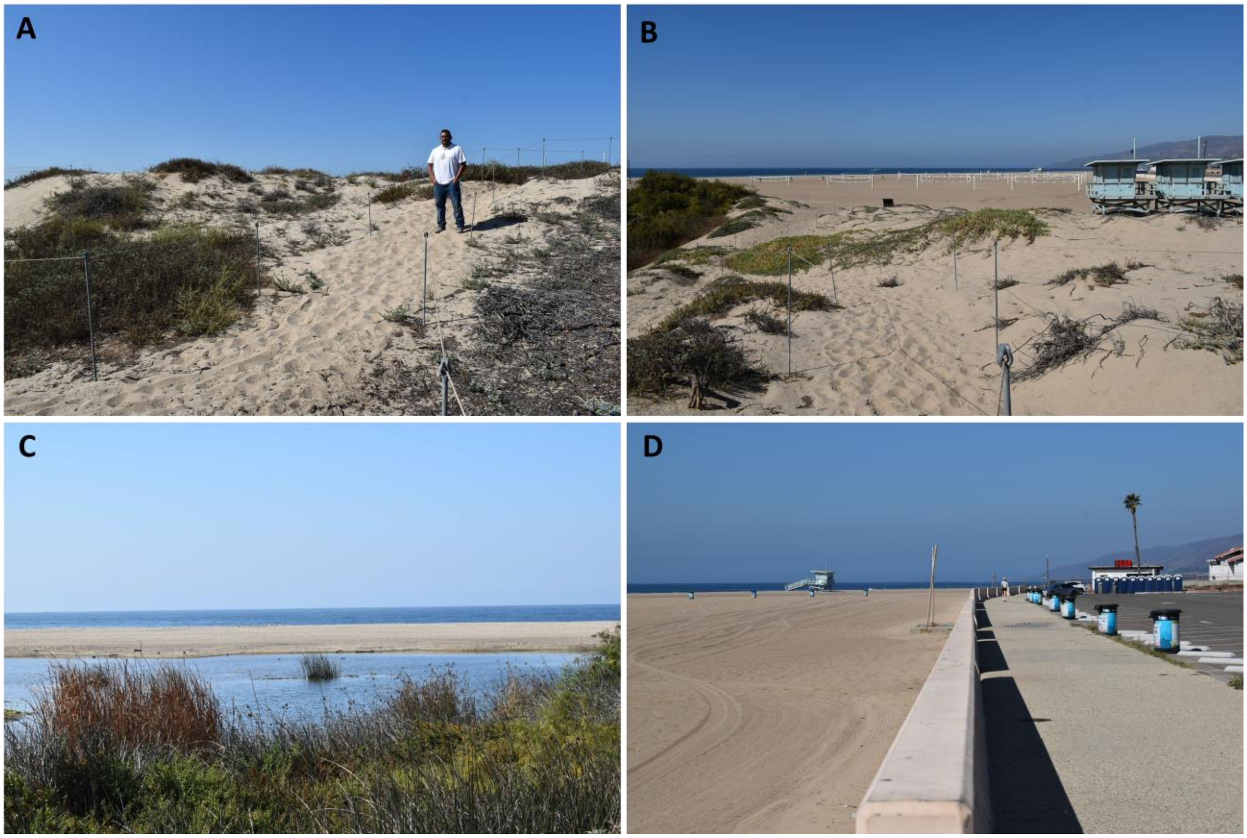



***Figure 4 Zuma Beach Existing Condition Photos (Taken Oct 4th, 2022): A. Dunes At The Mouth Of Zuma Canyon, B. Low Point At Volleyball Courts North Of Zuma Canyon, C. Mouth Of Zuma Canyon, D. Parking Lot And Concession***


***Figure 5. Point Dume Beach Existing Condition Photos (Taken Oct 4th, 2022): A. Access Road Connecting Zuma And Point Dume, B. Undermined Parking Lot With Concrete Cracks, C. Multi-Terrace Beach Profile, D. Steep Beach Profile***

## 4.2. Existing & Projected Risks

Natural beach erosion is an ongoing risk and challenge along Zuma and Point Dume causing a narrowing shore and threatening adjacent infrastructure. The existing beach retreat rate according to beach profile surveying by Coastal Frontiers is 3.6 feet per year along Zuma, and 1.9 feet per year along Pt. Dume Beach (Coastal Frontiers Corporation, 2017). An average of the two beach retreat rates (2.7 feet per year) may be able to represent an intermediate condition. According to beach profile surveys, the long-term beach width changes from mean sea level to the rear boundary of the beach are mainly negative along Zuma and Point Dume Beaches. Over the twenty-year period from 2002 to 2022, beach widths narrowed by an average of 3.5 feet along Zuma and 40 feet along Point Dume Beach (Coastal Frontiers, 2017). Short-term seasonal changes can be more dramatic at 84 feet of retreat from Fall 2021 to Spring of 2022 at Zuma, with a gain of 47 feet along Point Dume Beach. Although beaches are dynamic, it is important to note that the trend is erosion landward. Landward retreat of the beach reduces the recreational area of the beach, exposes infrastructure behind the beach to damage from seawater and waves, and can reduce the ecological habitat area of the sandy beach.

Assuming similar wave conditions continue to be present at the site in the future as exist presently, with a 3.6 feet per year rate of beach retreat along Zuma Beach, the beach may lose up to 38,000 square feet of area per year, or approximately 0.9 acres. Over time that loss could impact the capacity of the beach to provide recreational benefits to the region. Loss of valuable, sandy beach habitat reduces the habitat area used by fish, fauna, and birds. Its current status is in decline and additional loss would cause further detriment to regional ecology.[2]

Erosion also puts adjacent landward infrastructure at a higher vulnerability risk. At Zuma Beach, The LACDBH erects winter sand dikes along the beach to protect buildings behind the beach. Figure 6 shows aerial images of Zuma Beach in February 2022 showing a winter dike protecting a helipad, the lifeguard headquarters building, and two restrooms and in September 2023 with a wider beach and without winter dikes.


***Figure 6. Winter Sand Dike Along Zuma Beach In February 2022 (Upper Image) And September 2023 (Lower Image)***

Infrastructure along Point Dume Beach is also at risk. There is only one two-lane entrance road; the loss of protective sandy beach has threatened the entrance road to this beach and the response has been to install emergency rock shore protection along 1,600 of shoreline shown in Figure 7 below. Continued loss of sand along this reach could further threaten the road and cut off access to Point Dume Beach if more significant shoreline protection measures are not prioritized and implemented.

[2] The Beach Ecology Coalition provides important information pertaining to the value of this habitat within the region on this website address: https://www.beachecologycoalition.org/index.html.


*Figure 7. Emergency Rock Shoreline Protection At Point Dume Beach In February 2022*

Climate change and sea level rise will further exacerbate the potential loss of sandy beach along Zuma and Point Dume. As sea levels rise, beaches become narrower and retreat landward. Beaches that are already retreating are particularly vulnerable to accelerated retreat rates and more rapid loss over time. Both Zuma and Point Dume Beaches will experience more substantial problems associated with beach retreat in the future without intervention. The United States Geological Survey (USGS) utilizes a computer model called the Coastal Storm Modeling System (CoSMoS) to predict shoreline changes and potential coastal flooding from sea level rise. It factors in existing beach conditions and processes and provides graphic maps of changes during sea level rise from 0.25 to 2.0 meters (0.8 to 6.6 feet), with and without coastal storm wave conditions of various magnitudes. Example maps of 2 meter sea level rise conditions with an annual coastal storm is shown in Figure 8 for Zuma Beach and in Figure 9 for Point Dume Beach. Figure 8 highlights how public landward infrastructure may be subject to flooding from sea level rise in the absence of projects to increase resilience. If beach erosion accelerates in the future during sea level rise, the risk to recreational space, infrastructure, and habitat are all further at risk. Figure 9 does not show the same degree of flooding but shows the narrowing of the beach within a critical reach of the entrance roadway.


***Figure 8. Zuma Beach During 2 Meters (6.6 FEET) Of Sea Level Rise And An Annual Coastal Storm Wave Event From CoSMoS (Source: U.S.G.S.)***

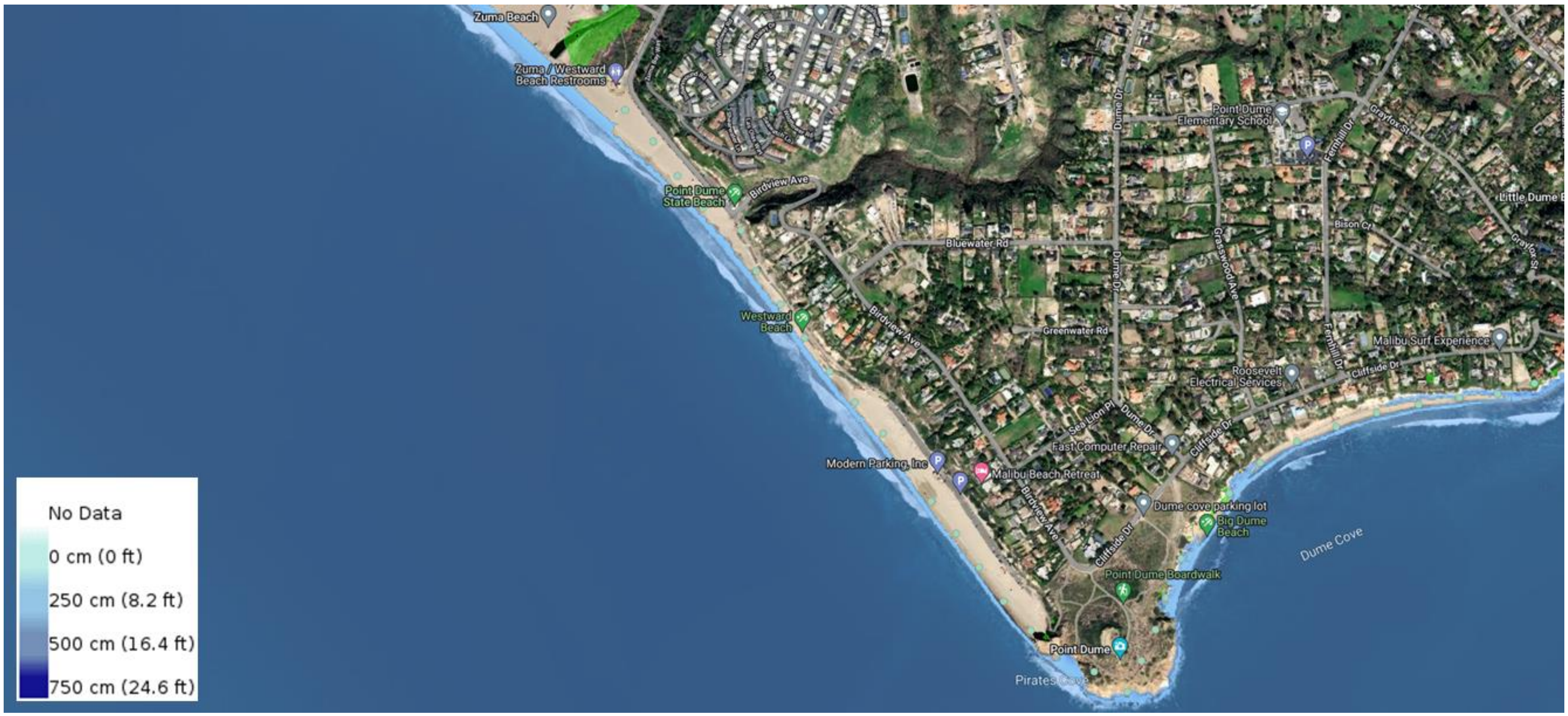



***Figure 9. Point Dume Beach During 2 Meters (6.6 Feet) Of Sea Level Rise And An Annual Coastal Storm Wave Event From Cosmos (Source: U.S.G.S.)***

## 4.3. Proposed Adaptation Strategy

The proposed adaptation strategy consists of nourishing the beach along Zuma Beach to widen the entire beach between the two headlands of Lechuza Point and Point Dume and adding dunes (living shorelines) at both Zuma and Point Dume Beaches. A State Marine Protected Area exists at Point Dume Beach that may limit the allowed activity, but sand placed along Zuma Beach outside of the restricted area will also provide benefits to Point Dume Beach as they are connected. Sand placed at Zuma Beach will also benefit the downdrift areas of L.A. County by natural sand transport because Zuma is located at the updrift end of the littoral cell and can serve to nourish sand to beaches downdrift (or to the east), as seen in Figure 10, further allowing the sand to move east and south to Santa Monica Bay.

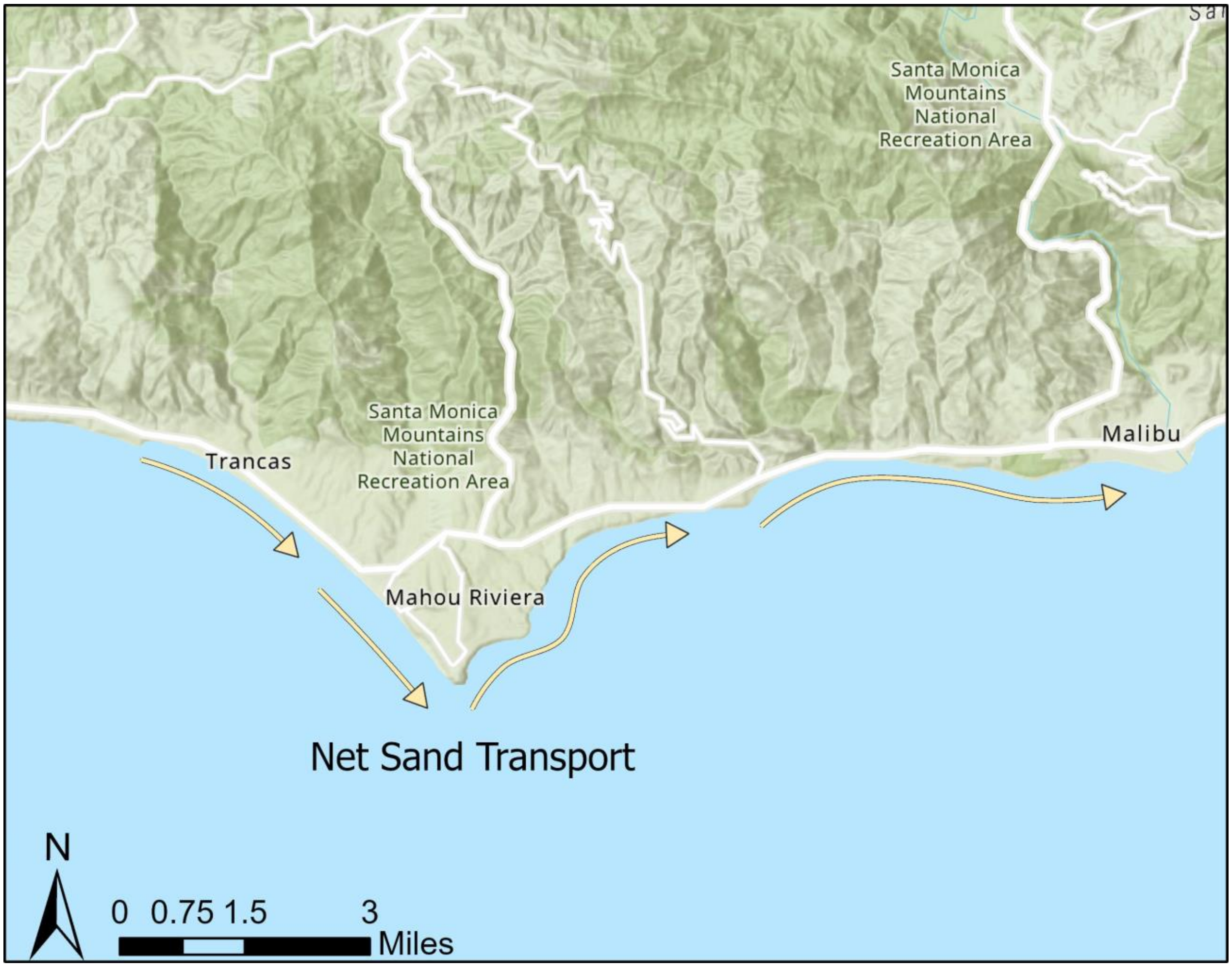



***Figure 10. Sand Moving Downcoast From The Zuma Beach Area To Santa Monica Bay***

Dunes are proposed at strategic locations where the beach is naturally wider than other areas as they can provide a reservoir of sand under extreme storm/erosion conditions and nourish the downdrift shoreline. The proposed project would maintain a sand beach backed by a restored dune system similar to that which may have historically existed along this reach of coastline. Figure 11 details the proposed locations for sand nourishment and living shoreline at both Zuma and Point Dume Beaches.


***Figure 11. Proposed Nourishment for Zuma And Point Dume Beaches***

The sand source is assumed to be offshore within Santa Monica Bay where prior sand source investigations done by Coastal Frontiers Corporation in 2012 identified high quality sand offshore of Venice Beach, Playa Del Rey (off of Dockweiler Beach), and Manhattan Beach for the Broad Beach Restoration Project. Sand placed within this reach would be held relatively stable between the physical boundaries of Lechuza Point to the northwest and Point Dume to the southeast. This project aims to increase the sediment supply to the northern beaches of L.A. County. Beach erosion along Zuma/Point Dume Beach is a natural process as sand is moved along the coast under the forces of wave-driven currents which has occurred for decades. An offshore submarine canyon exists just southeast of Point Dume Beach. The canyon head is in water depths greater than 60 feet and therefore it traps only a limited quantity of sand. It is not expected that a significant quantity of the newly added sand would be lost to the canyon over time. While sand retention structures (breakwaters, terminal groin, reefs, etc.) may also be beneficial, those alternatives were not explored due to permitting constraints associated with the existing State Marine Reserve (SMR) at the east end of this reach near Point Dume. The SMR prohibits actions such as construction of structures. Longer-term actions need to be evaluated to better protect and preserve coastal resources in the long-term with the effects of sea level rise.

## 4.4. Community Benefits

This Coastal Resiliency Study focused on selecting three beaches with a broad service area which in turn enhances the beach access for LA County residents. Because of their (1) location south of the Santa Monica Mountains and the roads through the canyons (i.e. Topanga Canyon Blvd, Las Virgenes Rd, Kanan Dume Rd, and Mulholland Hwy) connecting Malibu to the inland valleys, such as San Fernando Valley, Simi Valley, and Thousand Oaks, and (2) parking options including street parking and paid parking lots, Zuma and Point Dume Beach are strategic locations providing access to recreation and open space along the coastline to underserved inland communities from, but not limited to, the San Fernando Valley, Conejo Valley, Simi Valley, Granada Hill, Northridge, Canoga Park, and Reseda. Figure 12 illustrates the access roads from the inland areas to Zuma and Point Dume.


*Figure 12. Inland Access Roads To Zuma And Point Dume Beach*

By allocating resources to address erosion and future sea level rise at Zuma and Point Dume, LA County ensures public recreational opportunities, protects coastal infrastructure, enhances sensitive sandy beach habitat areas, and fosters local and regional economic benefits. A more resilient coastline not only allows the beach to serve as respite to offset discomfort and health threats associated with changing climate conditions, but it also has the potential reduce storm damage and their associated repair costs to public infrastructure behind the beach. An economic comparison of benefits to costs was conducted by the firm CETO for this project. It found that for every dollar spent on a project at this location, the economic return was $3.7, meaning that the benefit to cost ratio is 3.7:1. The spending made by beachgoers is approximately $62 per person for a day spent at the beach, and the attendance count was 1.9 million people in 2021. Therefore, the economic value of Zuma Beach was $117.8 million for that year for existing conditions. If the beach were widened by only 25 feet at a cost of $37 million, the economic return for the project would be $136.9 million because of the added recreational beach area available from the project.

## 4.5. Project Implementation

The order of magnitude construction cost estimate for Zuma/Point Dume Beach nourishment and dune project is roughly $37,300,000. Attachment A1 through A3 provide detailed construction estimates for each concept, with A1 pertaining to the Zuma/Point Dume Beach Project. Permits are required to implement beach nourishment with each permitting agency listed below having a central focus that may constrain the project. Permitting a project is challenging but feasible. The permits required to nourish Zuma Beach are:

- U.S. Army Corps of Engineers (USACE) – Sections 10 and 404 permits. Issuance of these permits requires the Corps to consult with NOAA NMFS and the USFWS where necessary for Essential Fish Habitat (EFH) and ESA issues. In the event a threatened or endangered species is present, an Incidental Take Statement will be required from the USFWS.
- California Coastal Commission – Coastal Development Permit.
- California State Lands Commission – Lease of State Lands for placement of sand below mean high tide line, which will include the requirement to perform a mean high tide line survey prior to placement.
- Regional Water Quality Control Board – Section 401 Certification for typical nourishment.
- Local Agencies – Potential permit required from the local agency. May include grading permit, Coastal Development Permit, special use permit, and variances to applicable ordinances. The County of Los Angeles and City of Malibu are the local agencies at Zuma Beach.

Separate permits may be required for the acquisition of the source material. For example, a grading permit may be required for upland construction generating opportunistic beach fill or a USACE permit may be required for dredging or excavation within the ocean, riverbed, lagoon, or embayment.

### 4.5.1. Engineering Design

Attachment B1 shows the engineering concept designs for the proposed project with a typical type of engineering concept plan view design of the beach fill and the engineering concept cross-section, respectively. The engineering plan view shows the typical type of footprint in length, width, and slope. Maximum beach width immediately after construction could potentially be between approximately 315 feet and 230 feet, however the conceptual width may never be achieved due to equilibration of the fill by the ocean during construction.

The design cross-section shows the engineered beach profile for existing conditions and the new profile after construction of the beach fill. While the existing slope is relatively flat, the constructed slope may be steeper at 10H:1V initially and then reform into a more natural flatter slope as the ocean forces work on the seaward edge. Engineering drawings are not provided for the dunes due to their naturalized appearance and layout.

### 4.5.2. Construction Approach & Windows

Beach Nourishment

L.A. County will consider sources of sand that exist both onshore (upland) and offshore in the shallow ocean for beach nourishment. Upland sources are typically limited in quantity and require transport via truck hauling. This type of nourishment is the goal of LACDBH’s Sand Compatibility and Opportunistic Use Program, or SCOUP. SCOUP provides planning for beneficial re-use of sediment from upland surplus deposits such as sediment detention basins, reservoirs, development projects, etc. The SCOUP concept was developed for the State of California (Moffatt & Nichol, 2006) and specifically applied in both Orange and San Diego Counties, and L.A. County is planning to implement the concept at this time.

However, as the project concepts presented herein consist of relatively large quantities of sand (e.g., 500,000 cubic yards), sand sources for beach nourishment are assumed to be offshore at larger-scale deposits. The work to dredge offshore and nourish onshore would be done using an ocean-going hopper dredge. The hopper dredge is a self-propelled vessel/container that moves from the borrow site to the placement site. It can hold between 2,500 and 5,000 cubic yards of sand, depending on its size. Figure 13 shows an example of a hopper dredge. The sand source is assumed to be off of Dockweiler Beach where large quantities of sand were identified in a prior investigation (CFC 2012) as shown in Figure 14. The vessel would then steam to the placement site and anchor offshore to pump sand from its hopper through a discharge line to the beach. These dredging and offloading cycles would continue until the desired quantity was placed on the beach.

***Figure 13. Hopper Dredge Pumping Sand Onto Cardiff Beach As Part Of San Diego Regional Nourishment***

Sand placed on the beach is placed within a diked-off containment area that allows the sand to settle out of the slurry and the water to drain to sea. Bulldozers then move and shape the sand into the design template consisting of a level beach berm at +12 feet above National American Vertical Datum of 1988 (NAVD88) of a specified width, and a slope toward the water at between 1V:5H to 1V:10H.

The process requires approximately between one to two months to complete, assuming that the dredge can produce approximately 10,000 to 20,000 cubic yards per day. The equipment typically works non-stop for 24 hours per day and seven days per week. Work stops when the equipment is either damaged or needs servicing.

The optimal time to conduct the work is during the relatively calm sea conditions of summer and fall seasons. Winter and spring can present coastal storm wave conditions that could shut down work temporarily. Benefits of doing the work in the spring season are that the sand can be available throughout the high beach use season of summer for recreation. The disadvantage of doing the in the fall season is that the sand can be eroded and dispersed from the target beach during the following winter thus rendering the beach less nourished by the following summer.


***Figure 14. Dockweiler Offshore Sand Investigation Area And Target Dredge Area***

Environmental windows that can be restrictive to beach nourishment consist of the following:

- Grunion spawning – From approximately March 1st to August 30th (at the absolute latest, sometimes August 1st).
- Recreational beach use – From Memorial Day to Labor Day, inclusive. The agencies discourage and sometimes refrain from beach construction during summer season.
- Bird breeding – Less of a concern at Zuma and Redondo, the bird breeding season is typically February 15th through September 15th. This may be more of an issue where existing dunes may hold snowy plovers such as at Westward Beach and possibly Dockweiler Beach.

Working from September 15th to February 15th of any year is a relatively safe environmental window. However, they are at odds with the best season to build beaches considering ocean conditions (avoiding winter and spring) and nourishing beaches to be at their widest at the start of the summer high intensity beach use season (Memorial Day).

Dune Restoration

Dune restoration and expansion can be accomplished using earthmoving equipment such as front-end loaders and/or bulldozers to move sand into the dune template. The equipment would sculpt the dunes in place as hummocks to mimic the natural dune mound feature.

Environmental windows that can be restrictive to beach dune construction are the same as those for beach nourishment, with the exception of grunion spawning not being a constraint for dune construction.

Beach Renourishment

Sand along Zuma is anticipated to disperse and gradually move out from the project to beaches farther west and east. As the sand disperses, Zuma Beach will retreat toward its existing beach width condition; at some point, LACDBH may wish to renourish the beach to widen it again in the future. The frequency and quantity of renourishment depends on the beach retreat rate (sand loss rate). The existing beach retreat rate according to beach profile surveying by Coastal Frontiers is 3.6 feet per year along Zuma, and 1.9 feet per year along Point Dume (Coastal Frontiers Corporation, 2017). If both beaches are to be nourished, then an average of the two beach retreat rates may be able to represent an intermediate condition. The average beach retreat rate of both beaches is 2.7 feet per year.

Assuming similar wave conditions continue to be present at the site in the future as exist presently, then the future sand loss rate can be assumed to be similar. Hence, the beach may lose up to 38,000 square feet of area per year along the 14,000-foot-long reach from Trancas Creek to Point Dume. Using the USACE "rule of thumb" that 1.5 cubic yards of sand is required to create 1 square foot of beach in southern California (Joseph Ryan, Personal Communication, 2012), the sand volume loss equals 57,260 cubic yards of sand per year (38,173 square feet X 1.5 cubic yards per square foot). The lifespan of the 500,000 cubic yard beach fill project would be 8.7 or 9 years (500,000 cubic yards / 57,260 cubic yards per year lost). Therefore, renourishment of the beach may be required approximately every 8 to 10 years. This is similar to the projection at nearby Broad Beach of the need to renourish 450,000 cubic yards of beach fill every 10 years (Moffatt & Nichol, 2013).

Triggers for Renourishment

If sea levels were to rise according to the SLR projections in Table 1, then the beach will retreat landward along with rising ocean levels. The amount of beach retreat would depend on the rate of SLR and the slope of the beach. If the beach slopes at 1V:10H (Vertical:Horizontal), then 1 foot of sea level rise would result in 10 feet of horizontal beach retreat. If the beach slope is flatter at 1V:20H then the horizontal distance of retreat of the beach would be 20 feet for 1 foot of sea level rise. The existing slope at Zuma is 1V:30H, so under the near-term scenario for medium-high risk aversion the retreat of Zuma would be 78 feet (2.6 feet of SLR in 2050-2060 on a slope of 1V:30H), and under the mid-term timeframe the retreat would be 132 feet (4.4 feet of SLR in 2050-2060 on a slope of 1:30). This assumes that the slope of the beach in the future would be similar to the existing slope; This assumption may not apply if the sand placed as nourishment is different in grain size than the sand on the beach currently.

If the beach retreats in the future more rapidly than the current rate of retreat, then the beach renourishment rate and quantity may need to increase to keep pace with SLR. For example, if SLR was 2.6 feet over the near-term in 2050-2060, then Zuma would lose sand at a rate of 2.7 feet per year (existing) + 3.9 feet per year from SLR at 2050 (78 feet over 20 years on a 1:30 slope) for a total rate of 6.6 feet per year. The renourishment rate would need to be 500,000 cubic yards of sand every 3.6 years. The calculation to arrive at that interval is:

- 6.6 feet of retreat x 14,000 linear feet of beach = 92,400 square feet of beach area reduction.
- 92,400 square feet of beach area x 1.5 cubic yards per square foot of beach = 138,600 cubic yards of sand eroded each year.
- 500,000 cubic yards of sand placed divided by 138,600 cy lost per year = 3.6 years longevity of the beach fill.

Therefore, in the future given certain SLR rates, beach nourishment may need to occur more often and/or with larger quantities to keep pace with SLR to maintain resilience. It may prove beneficial to increase the quantity and maintain a nourishment interval of every 8 to 10 years. Other projects in the region may be occurring on a similar timescale that may offer LACDBH an opportunity to share some of the costs (e.g., Broad Beach Restoration Project).

# 5. Dockweiler State Beach

Dockweiler State Beach is in the Santa Monica Bay, in the Playa del Rey neighborhood at the western terminus of Imperial Highway as shown in Figure 15. It fronts 3.7 miles of ocean and 288 acres of beach. Amenities include restrooms, showers, picnic facilities, fire rings, volleyball nets, a youth center, and hand glider facilities. The Marvin Braude Bike Trail, also known as the beach public path, is readily accessible and commonly used for walking, rollerblading, jogging, and bicycling. Groins at the north end of the beach provide ideal fishing opportunities with shore fishing also being popular. Dockweiler Beach has over 1,200 available parking spaces and a Recreational Vehicle Park with 118 full hook-up spaces (LACDBH, 2021). Dockweiler Beach receives an average of 1.1 million beach day visits per year.


***Figure 15. Dockweiler State Beach Location***

Dockweiler is quite expansive with a surplus sand that blows onto landward amenities such as the Marvin Braude Bike Trail and parking lots. This location experiences problems with loss of beach sand by excessive wind-blown sand moving onto a public bicycle/pedestrian path and parking lot. Capturing sand with sand dunes may reduce the sand quantity blown onto the public pathway and parking lot and provide more buffer during sea level rise.

## 5.1. Existing Conditions & Risks

Similar to Zuma Beach, the existing physical condition of Dockweiler Beach was assessed by calculating the beach width, erosion rate, and berm elevation; results are shown in Table 6.

***Table 6. Dockweiler Beach Existing Conditions***

| Beach | Avg Width (ft) | Min Width (ft) | Erosion Rate (ft/yr) | Berm Elevation (ft NAVD88) |
|---|---|---|---|---|
| **Dockweiler** | 394 | 226 | -4.6 | +11.4 |


***Figure 16. Dockweiler Beach Existing Condition Photos (Taken Oct 5th, 2022): A Wide Beach Berm With Fire Pits, B Vegetated Dunes Used For Paragliding, C Sheet Pile Groin With Typical Downdrift Accretion/Updrift Erosion Response, D ADA Access***

Existing risks at the site consist mainly of wind-blown sand depositing on the public bike/pedestrian pathway and in the parking lot behind the beach. Sand deposited in those places poses risks to those using the public pathway and the parking lot. Traction on the pathway is compromised which poses a safety risk for users. The maintenance effort to clear the sand accumulated in the parking lot requires County resources and budget; unfortunately, sand clearing efforts in the parking lot have led to damage to the perimeter fencing. Future risks will likely remain similar to existing risks, with potentially more sand blowing onto the pathway and parking lot overtime. Sea level rise may not reach the back of this beach nor the public pathway or parking lot. However, if sea level rise occupies more of the sandy beach area, the creation of additional dunes to contain and store more sand will benefit the site by providing a reservoir of sand for future release during storms. Dunes as a sand retention strategy should also reduce the nuisance condition of wind-blown sand on the pathway and in the parking lot.

## 5.2. Proposed Adaptation Strategies

The concept alternative for this site includes installation of the following components:

- A relatively low barrier wall along the bicycle path western edge to block wind-blown sand from moving directly onto the path and parking lot.

- Sand collection fencing on the beach and sand dune field west of the bike path to encourage sand deposition at the dunes seaward of the bike/pedestrian path and parking lot, including guidance on sand fence maintenance.

The two important considerations for the sand transport low barrier wall are that:

- It needs to be short enough to allow a person of average adult height to be able to easily move over it while carrying beach gear, and
- The foundation needs to be narrow and shallow to occupy as small of a footprint as possible and thus not impact existing dunes.

The sand collection fencing on the beach will result in improved public access, reduced ongoing maintenance needs, and potential benefits to nearby dunes by reducing loss of sand onto parking areas. The intent is to establish sand dune habitat west of the existing sand dune field at the site and trap sand prior to it reaching the bicycle/pedestrian path. Additionally, the habitat at the dunes could be improved in quality by removing non-native species that are present and seeding it with native species. A sample sand collection fencing for the sand dunes is shown in Figure 17.


***Figure 17. Sample Sand Collection Fencing (Mobi-Mat, 2023)***

Figure 18 shows the concept at Dockweiler Beach; the project was designed to not extend farther south to prevent a conflict with hang-gliders that use the rear portion of the beach as a take-off zone. Figure 19 shows an example of the low sand management barrier wall as taken from Zuma Beach.

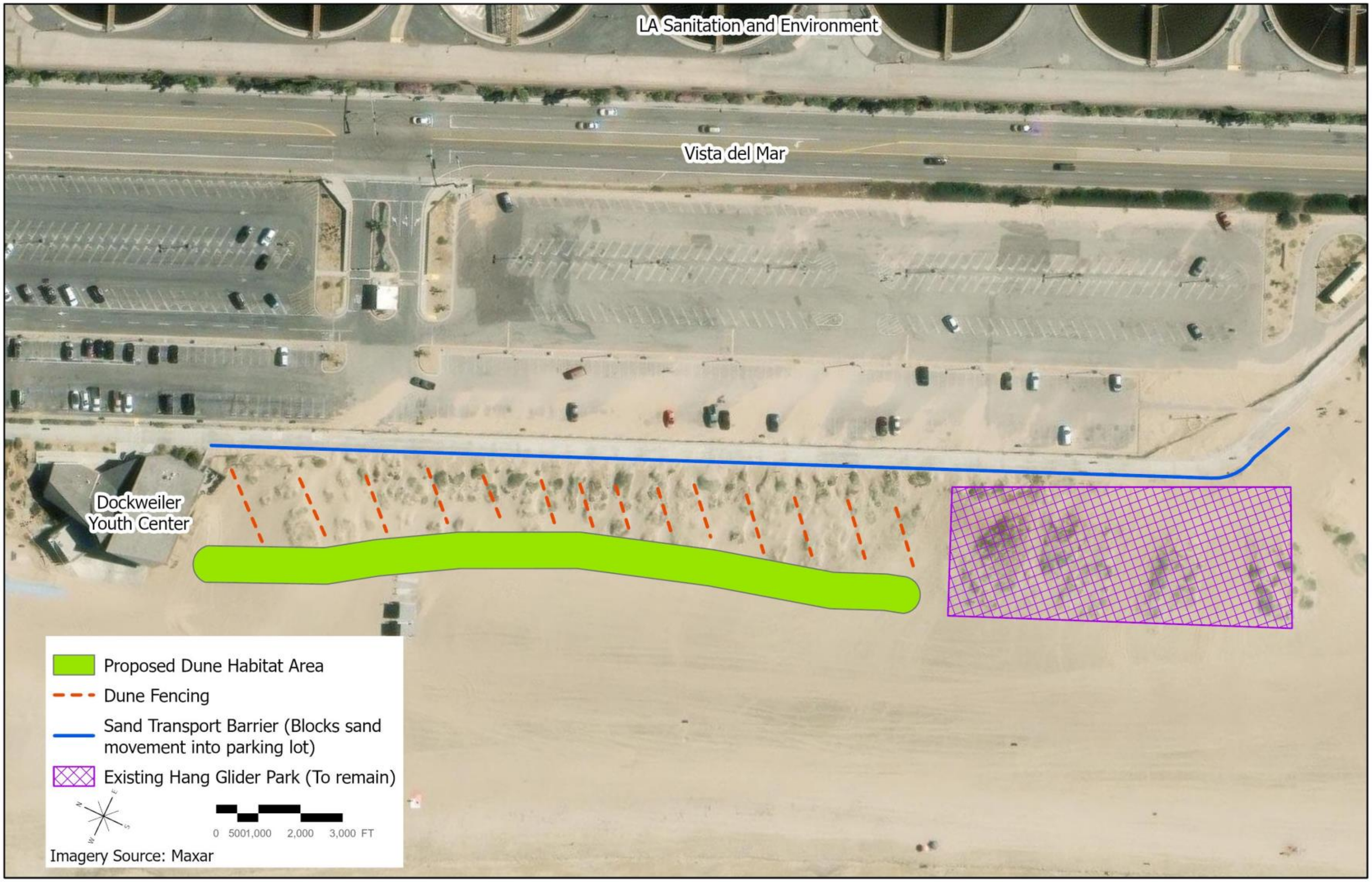



***Figure 18. Proposed Dockweiler Beach Sand Management And Dune Expansion***

*Figure 19. Example Sand Management Low Barrier Wall At Zuma Beach*

## 5.1. Community Benefits

Similar to Zuma and Point Dume Beach, Dockweiler was selected because of its unique features, road connections, and parking that combined provide access and a meaningful public space to inland communities. With its proximity to the I-105 freeway corridor, Dockweiler provides beach access to several underserved communities in LA County including Inglewood, Lennox, Hawthorne, and Westmont. Figure 20 illustrates the access roads from the inland areas to Dockweiler.


*Figure 20. Inland Access Roads To Dockweiler Beach*

The proposed project will yield improvements to the public pathway and overall visitor experience. In addition, ecological benefits will be realized by expanding the sand dune habitat area for sensitive species. The dunes will grow, and the sand deposition on the pathway and parking lot will be reduced. Larger dunes will also provide greater sand storage for release back to the beach during sea level rise if storms erode the dunes during sea level rise.

## 5.2. Project Implementation

The timeframe for implementation of the Dockweiler Beach project is near-term, within the next five years if possible. Problems associated with sand movement onto the public pathway and the parking lot are immediate and urgent. This strategy can be effective into the long-term between 2070 and 2100 because sea level rise may not affect the site due to the wide beach (roughly 250 feet).

Dune restoration and expansion can be accomplished using sand fencing to collect sand blown by the wind. Sand fencing can be installed by hand with shovels. Dunes already exist at the site and this project is simply allowing them to expand toward the west, no mechanical construction is needed. Environmental windows that can be restrictive to installing the sand fences may consist of the following:

- Recreational beach use – From Memorial Day to Labor Day, inclusive. The agencies discourage and sometimes refrain from beach construction during summer season.
- Bird breeding –The bird breeding season is typically February 15 through September 15. This may be more of an issue where existing dunes may hold snowy plovers at Dockweiler Beach.

Erection of the low sand blocking wall can occur nearly anytime of the year but should be limited to outside of the summer beach season to minimize conflicts, and potentially outside of the bird breeding season if snowy plovers are detected in the dunes or on the beach near the wall. The wall is likely to be cast in place, made with colored concrete, and sculpted to present a naturalized and aesthetically pleasing feature.

The width of the beach at Dockweiler Beach is approximately 250 feet from the seaward edge of existing dunes to the wetted boundary at the ocean. This distance is sufficient to buffer the proposed additional sand dune from sea level rise in the near- and mid-term timeframes. Therefore, the proposed project is resilient and sustainable during the foreseeable future with SLR. No further adaptation measures appear to be necessary at this time. For verification, the CoSMoS SLR model was consulted for future conditions. The model shows that with SLR at approximately 4.4 feet at the mid-term future (2080) that conditions at Dockweiler are dry at high tide. However, if a 20-year coastal storm is added to the scenario then the dunes might experience minor wetting by the ocean. This is the condition that the dunes are intended to block; thus, the dunes are consistent with their purpose and function.  Figure 21 shows CoSMoS result for 4.4 feet of SLR both with and without a 20-year coastal storm.

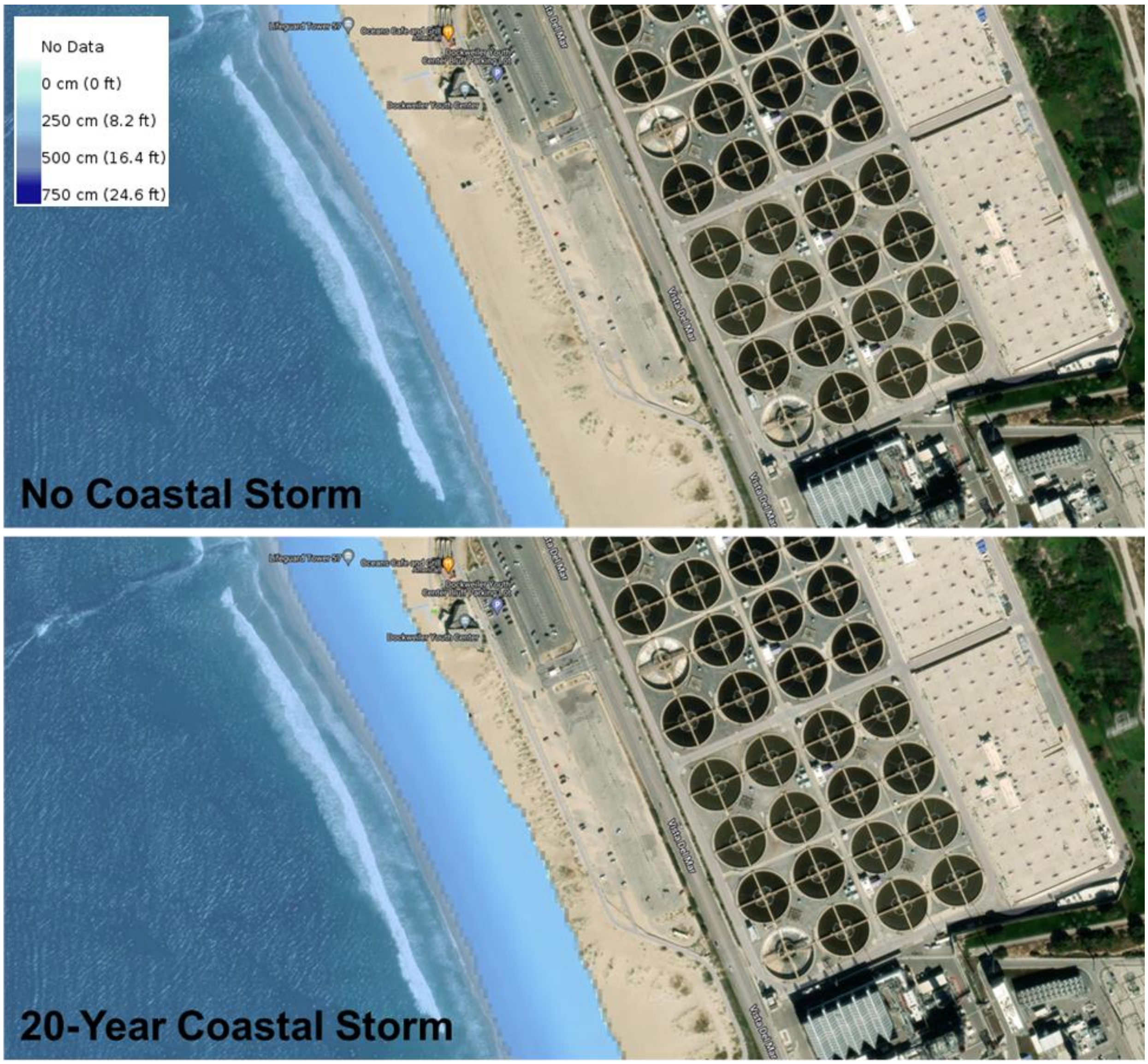



***Figure 21. CoSMoS SLR Projection Of 4.4 Feet For Dockweiler Beach With And Without A "Coastal Storm" Condition***

Permits are required to implement sand dune habitat enhancement. Each permitting agency will have central focus issue areas that will constrain a project. Permitting a project is feasible and is less challenging than for the other projects because sand is not proposed to be placed within waters of the U.S. The permits required to nourish Dockweiler Beach are:

- California Coastal Commission – Coastal Development Permit.

- Local Agencies – Potential permit required from the local agency. May include grading permit, Coastal Development Permit, special use permit, and variances to applicable ordinances. The County of Los Angeles and City of Los Angeles are the local agencies at Dockweiler Beach.

The order of magnitude construction cost estimate for this sand management and dune project is roughly $2,800,000. Attachment A2 provides the detailed construction estimate for the Dockweiler Beach Project.

# 6. Redondo Beach

Redondo Beach is in the Santa Monica Bay, in the City of Redondo Beach. The entire beach is over a mile and a half long and it runs south from the Redondo Beach Pier to Torrance Beach. However, the project is focused on the short reach nearest the pier shown in Figure 22. There is a parking structure for the pier along with street parking. Amenities include showers, restrooms, and volleyball nets. The beach is great for swimming, surfing, and windsurfing and the horseshoe-shaped pier is good for fishing and has many restaurants and shops (LACDBH, 2021).

Infrastructure just landward of the beach along South Redondo consists of the main access point, a boardwalk, and parking lots. The main access point is a hub for people arriving and departing and it provides access to mass transit with bus facilities. The entrance to the pier is adjacent to this access point. The main access point and parking lots are located on higher ground on a low bluff east of the beach and appear to be protected due to their elevation. However, a major storm drain outlet exists out on the beach near the end of Sapphire Street that is vulnerable to damage by waves.


***Figure 22. Redondo Beach Location***

Per the economic study by CETO in Attachment C, despite being significantly smaller than some of other beaches in Santa Monica Bay, South Redondo Beach receives an average of 1.5 million beach day visits per year according to official counts by LA Beaches and Harbors. Currently just under half of all beach days are over capacity; high season days (June, July, and August) are over capacity on 64% of days, which indicates that Redondo Beach is less seasonal than beaches such as Zuma Beach.

## 6.1. Existing Conditions & Risks

The existing physical condition of South Redondo Beach consists of the beach width, berm elevation, and erosion rate. South Redondo Beach is experiencing narrowing of the beach just to the south of the pier. As such, it is a vulnerable beach that may not be wide enough to provide protection to infrastructure behind the beach, nor wide enough to meet the recreational beach use demand. See Table 7 and Figure 23 below showing the narrow width of this reach of beach.

***Table 7. Redondo Beach Existing Conditions***

| Beach | Avg Width (ft) | Min Width (ft) | Erosion Rate (ft/yr) | Berm Elevation (ft NAVD88) |
|---|---|---|---|---|
| **Redondo** | 157 | 85 | Approximately -2.8 | +15.1 |


***Figure 23. South Redondo Beach Existing Condition Photos (Taken Oct 5th, 2022): A. Overview With Volleyball Courts, Lifeguard Tower, And Groin, B. Sand Moving Equipment, C. Cross-Shore Structure, D. Groin With Typical Downdrift Accretion/Updrift Erosion Response***


*Figure 24. Redondo Beach Existing Beach Width Conditions*

The pocket beach between the pier and Topaz groin does not appear to possess a constant high retreat rate based on review of aerial images. It appears to have reached a more stable condition with a more modest retreat rate given the existing site constraints of a groin downcoast, the pier and harbor entrance upcoast, and canyon offshore and to the northwest. Generally, the beach has still narrowed over time compared to the area south of Topaz Groin and retreated landward. This landward retreat of the beach reduces the recreational area of the beach, exposes infrastructure behind the beach to damage from seawater and waves, and can reduce the ecological habitat area of the sandy beach.

Sea level rise will further exacerbate the potential loss of sandy beach along South Redondo Beach. As sea levels rise, beaches become narrower and retreat landward in response. Beaches that are already in a retreated state or retreating are particularly vulnerable to accelerated retreat rates and more rapid loss over time. South Redondo Beach will experience more substantial problems associated with beach retreat in the future without intervention due to its relatively narrow footprint. Figure 25 shows 2-meter (6.6 feet) sea level rise conditions with an annual coastal storm which creates coastal flooding of infrastructure in the future from sea level rise alone in the absence of coastal resilience projects. If beach erosion accelerates in the future during sea level rise, then the risk to recreational space, the beach boardwalk, and sandy beach habitat are all further at risk.

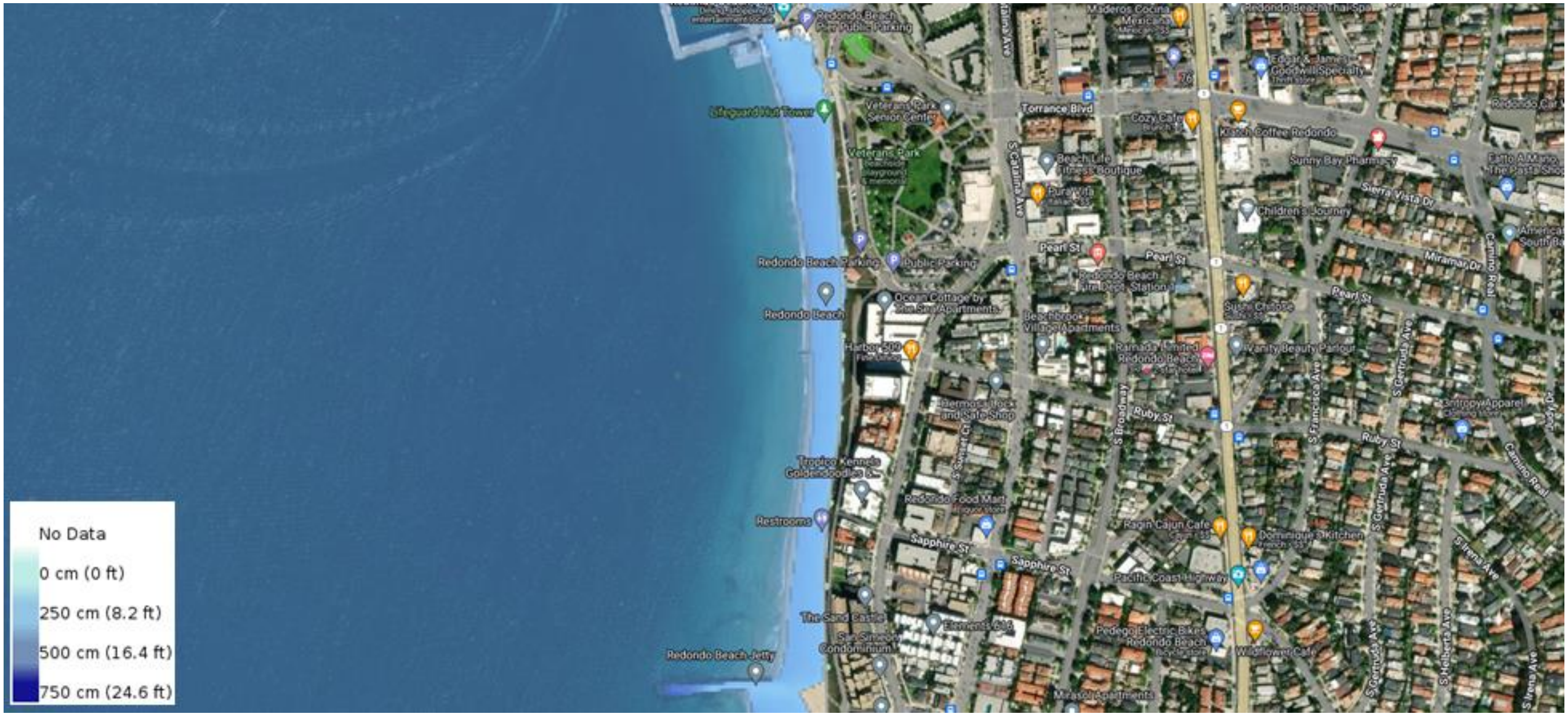



***Figure 25. CoSMoS 2m SLR 1yr Storm***

## 6.2. Proposed Adaptation Strategies

The project includes 315,000 cy of beach sand nourishment to widen the beach and installation of an eco-friendly sand retention device at the pier to hold the sand in place. The sand retention device being considered is a pilot concrete sheetpile groin along the south edge of the pier that consists of materials such as ECOncrete instead of traditional concrete to promote marine growth. This technology is being incorporated more widely into projects in southern California (e.g., San Diego Bay by the Port of San Diego) and elsewhere to bring green solutions to gray infrastructure. Concrete is often used in the marine environment to provide structural solutions to erosion problems. One similar example within the region is the concrete groin existing alongside Seal Beach Pier that retains sand at a pocket beach that has a similar configuration to this site. This structure was the inspiration for the concept at South Redondo Beach. Figure 26 shows the concept for South Redondo Beach.

The living shoreline area would be seeded dune habitat and bounded by a post and rope or cable barrier to discourage trespassing, with informational signage for the public as an educational/interpretive opportunity. Dunes provide a temporary site for additional sand storage to increase protection and resilience to the site during severe coastal storms and during sea level rise. This dune system is proposed as a demonstration project to inform the public and serve as an example of measures being applied at other locations. It is positioned at the location shown to remain out of the primary footprint of primary beach use areas to avoid being trampled and/or presenting a conflict to beach use. It is also positioned at the rear of the beach and near the pier intentionally to have the advantage of maximum protection from the new widened beach nearest to the proposed sand retention structure to minimize the probability of incurring storm wave damage.

The presence of an offshore submarine canyon is a consideration taken into account in this concept design. Submarine canyons present the potential for sand loss during certain conditions, such as significant storm wave events. This canyon is relatively far enough offshore and positioned farther north than this beach is located, and in deep enough water to be beyond the nearshore littoral zone of sand movement specifically from this pocket beach. It could trap sand moving offshore during storms from this beach if that sand traveled northward. Therefore, in the engineer's judgement this canyon would not pose a significant constraint of capturing sand from this project except possibly under the most extreme storm wave events. The probability of those events occurring is sufficiently remote to not necessarily limit this alternative from being considered. If necessary, the proposed sand quantity could be modified based on post-construction monitoring results to consider the effects of the submarine canyon.

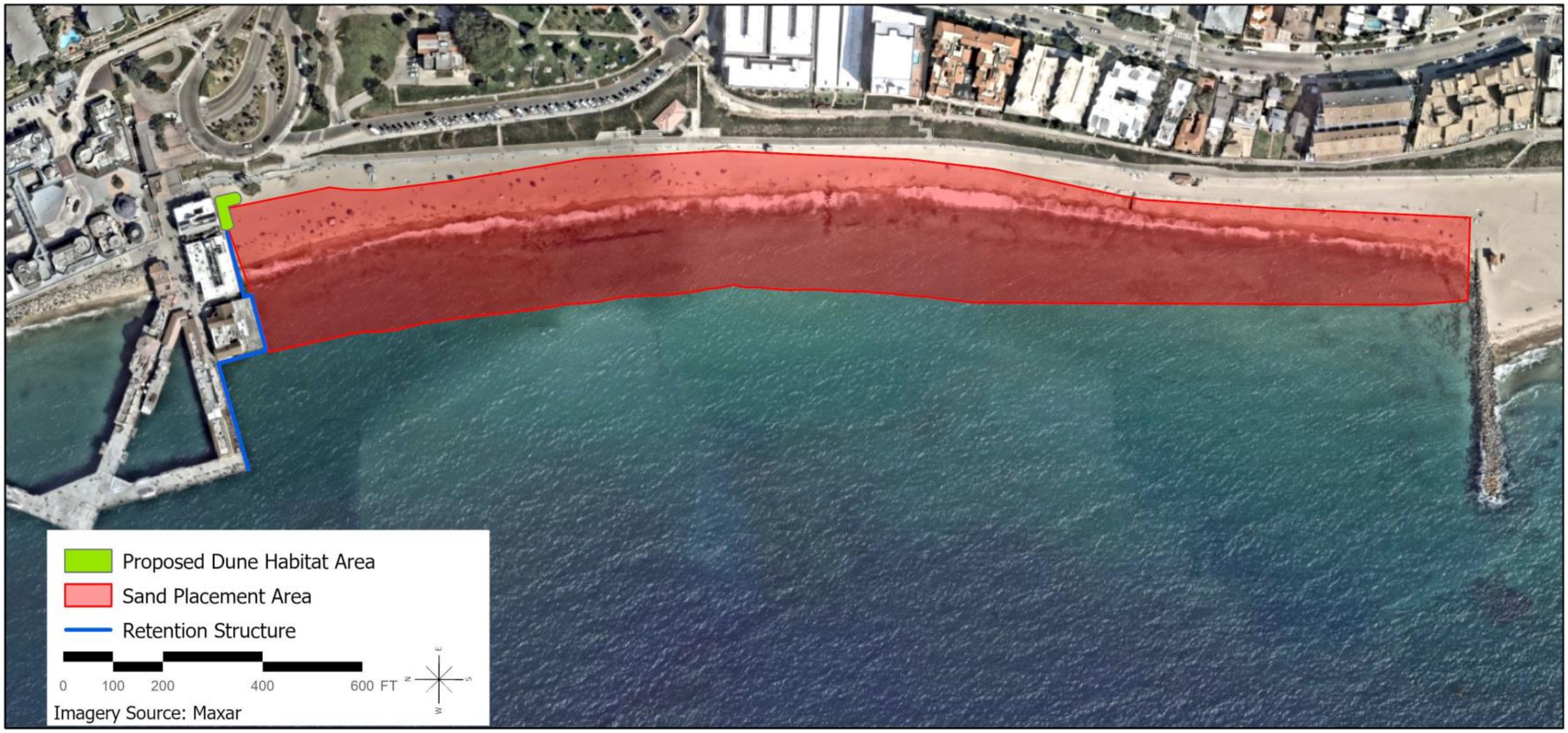



***Figure 26. South Redondo Beach Nourishment, Retention, And Dune Habitat Creation***

## 6.3. Community Benefits

Redondo Beach connects to the adjacent inland communities of Torrance and Carson via surface roads such as Torrance Blvd and Sepulveda Blvd. This beach has particular attraction due to its location adjacent to the pier and associated shops, restaurants, and entertainment. It is a multiple type of entertainment venue for the public in one trip. Figure 27 illustrates the access roads from the inland areas to Redondo Beach.

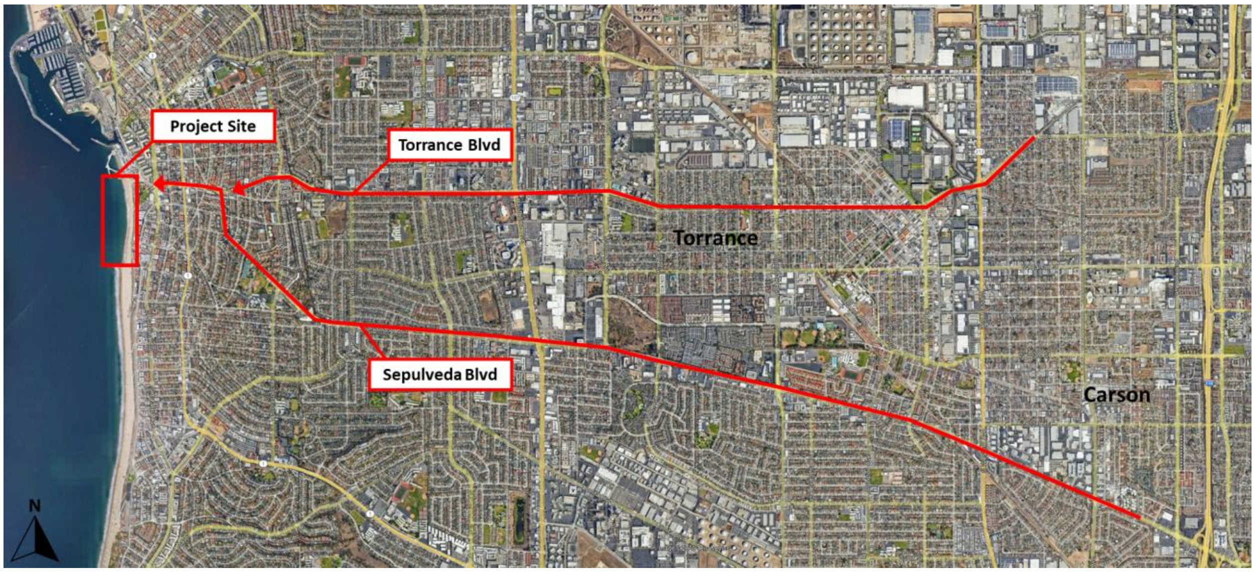



***Figure 27. Inland Access Roads To Redondo Beach***

By allocating resources to address erosion and future sea level rise Redondo Beach, LA County ensures public recreational opportunities, enhances sensitive sandy beach habitat areas, and fosters local and regional economic benefits. A more resilient coastline not only allows the beach to serve as respite to offset discomfort and health threats associated with changing climate conditions, but it also has the potential reduce storm damage and their associated repair costs to public infrastructure behind the beach. A Regional Economic Impact Assessment was conducted by the firm CETO for this project and found that for every dollar spent on a project at this location, the economic return was $4.7, meaning that the benefit to cost ratio is 4.7:1. The spending made by beach-goers is approximately $62 per person for a day spent at the beach, and the attendance count was 1.5 million people in 2021. Therefore, the economic value of Redondo Beach was $93 million for that year for existing conditions. If the beach were widened by 170 feet at a cost of $27 million, then the economic return for the project would be roughly $126 million because of the added recreational beach area available from the project.

## 6.4. Project Implementation

This project consists of beach sand nourishment, installation of a sheet pile sand retention measure along the base of the pier piles, and dune restoration. The timeframe for implementation of the Redondo Beach project is near-term or within the next five to ten years if possible. The beach is presently vulnerable to damage from winter storm wave conditions, and it could become more vulnerable as sea level rise occurs. Sand nourishment can be re-applied over time (i.e., every 10 to 15 years, if needed) during relatively modest amounts of sea level rise (approximately 1 to 2 feet, estimated to be between the years 2030 and 2050). Attachment B2 shows the engineering concept designs for the proposed project, including a typical engineering concept plan view design of the beach fill and the engineering concept cross-section. The engineering plan view shows the footprint dimensions of length, width, and slope. Maximum beach width immediately after construction could potentially be between approximately 290 feet and 172 feet (assumed to be 170 feet for planning purposes), however the concept width may never be achieved due to equilibration of the fill by the ocean during construction. The engineering cross-section shows the beach profile for existing conditions and the new profile after construction of the beach fill. The constructed slope at 5H:1V may be steeper than the natural slope initially and then reform into a more natural flatter slope as the ocean forces work on the seaward edge. Engineering drawings are not provided for the dunes due to their naturalized appearance and layout.

Permits are required to implement beach nourishment and sand retention. Each permitting agency will have central focus issue areas that will constrain a project. Permitting a project is feasible but is challenging. The permits required to nourish Redondo Beach and install a sand retention structure along the outer side of the pier are:

- U.S. Army Corps of Engineers (USACE) – Sections 10 and 404 permits. Issuance of these permits requires the Corps to consult with NOAA NMFS and the USFWS where necessary for Essential Fish Habitat (EFH) and ESA issues. In the event a threatened or endangered species is present, an Incidental Take Statement will be required from the USFWS.
- California Coastal Commission – Coastal Development Permit.
- California State Lands Commission – Lease of State Lands for placement of sand below mean high tide line, which will include the requirement to perform a mean high tide line survey prior to placement.
- Regional Water Quality Control Board – Section 401 Certification for typical nourishment.
- Local Agencies – Potential permit required from the local agency. May include grading permit, Coastal Development Permit, special use permit, and variances to applicable ordinances. The County of Los Angeles and City of Redondo Beach are the local agencies at South Redondo Beach.

Separate permits may be required for the acquisition of the source material. For example, a grading permit may be required for upland construction generating opportunistic beach fill or a USACE permit may be required for dredging or excavation within the ocean, riverbed, lagoon, or embayment. The order of magnitude construction cost estimate for this beach nourishment, retention, and dune project is roughly $26,800,000. Attachments A3 provides the detailed construction estimate for the Redondo Beach Project.

### 6.4.1. Construction Approach & Windows

Beach Nourishment

As sea levels rise the projects may need to be adapted to provide resilience up to a specified end point or functional project life. The near-term is defined as the next 20 to 30 years and the mid-term is considered 30 to 50 years. If sea levels were to rise according to projections, the beach will retreat landward along with rising sea levels. The amount of beach retreat would depend on the rate of SLR and the slope of the beach. The existing slope at Redondo Beach is 1V:20H; so, under the near-term scenario for medium-high risk aversion the retreat of Redondo would be 52 feet (2.6 feet of SLR on a slope of 1V:20H), and under the mid-term timeframe the retreat would be 88 feet (4.4 feet of SLR on a slope of 1V:20H). This assumes that the slope of the beach in the future would be similar to the existing slope.

The project proposes to widen the beach by 250 feet; hence, if the two retreat distances of 52 and 88 feet were added together then the total retreat over 40 years would be 140 feet. That would leave a beach width of 110 feet remaining from the original 250-foot added constructed width when renourishment would be needed at that point. Therefore, in the future given certain SLR rates, beach nourishment may need to occur periodically (every 40 years at a volume of 315,000 cy or more frequently at a lower sand volume) to keep pace with SLR to maintain resilience. This analysis was done differently than that for Zuma Beach because Redondo Beach will be a pocket beach with sand retention structures on each end that will retain sand in between them. Thus, this site is not expected to lose sand at the same rate as an unstable beach such as Zuma.

As this project is very similar to beach nourishment at Zuma Beach, the nourishment component of this project is also assumed to be done using an ocean-going hopper. The hopper dredge would remove sand from the ocean bottom at the sand source location which is assumed to be off of Dockweiler Beach. The vessel would then travel to the placement site and anchor offshore to pump sand from its hopper through a discharge line to the beach. These dredging and offloading cycles would continue until the desired quantity was placed on the beach. Sand is placed on the beach within a containment area and then graded into the design template. The process can take between one to two months to complete. The equipment typically works non-stop for 24 hours per day and seven days per week. Work stops when the equipment is either damaged or needs servicing.

The optimal time to conduct the work is during the relatively calm sea conditions of summer and fall seasons. Winter and spring can present coastal storm wave conditions that could shut down work temporarily. Benefits of doing the work in the spring season are that the sand can be available throughout the high beach use season of summer for recreation. The disadvantage of doing the in the fall season is that the sand can be eroded and dispersed from the target beach during the following winter thus rendering the beach less nourished by the following summer.

Environmental windows that can be restrictive to beach nourishment consist of the following:

- Grunion spawning – From approximately March 1$^{st}$ to August 30$^{th}$ (at the absolute latest, sometimes August 1$^{st}$).
- Recreational beach use – From Memorial Day to Labor Day, inclusive. The agencies discourage and sometimes outright black out the summer season from beach construction.
- Bird breeding – Less of a concern at South Redondo, the bird breeding season is typically February 15$^{th}$ through September 15$^{th}$.

Working from September 15$^{th}$ to February 15$^{th}$ of any year is relatively safe environmental window. However, they are at odds with the best season to build beaches considering ocean conditions (avoiding winter and spring) and having the beaches at their widest at the start of the summer high intensity beach use season (Memorial Day).

Sand Retention Sheet Pile Wall

The sand retention component of this project would require a concrete sheet pile driving along the pier piles from the pier deck assuming the pier can support construction loads. If the pier cannot support a piledriver, then the marine contractor may need to access the site from a barge alongside the pier. Piles can be vibrated into place in the ocean floor rather than being driven by a pneumatic hammer. Concrete piles are recommended to avoid the corrosion of steel and to allow for the opportunity to use Econcrete either for the actual pile materials (if that is possible considering concrete strength requirements) or for a coating on the piles to attract marine growth more effectively than standard concrete.

Dune Restoration

The dune restoration component of the project can be built using earthmoving equipment such as front-end loaders and/or bulldozers to move sand pumped onshore into the dune template. The equipment would sculpt the dunes in place as hummocks to mimic a natural dune mound feature. Amenities such as dune fencing to attract sand and low cable or rope and post fencing and interpretive signage would be installed concurrent with dune construction.

# 7. Funding & Partnership Opportunities

Chapter 7 presents an overarching strategy for building partnerships and seeking funding to support future implementation projects by identifying partnership opportunities and potential grant sources according to the project's proposed adaptation strategies. This chapter assumes that building partnerships will enable the LACDBH to increase funding opportunities for climate resilience projects in the near- and long-term and provides a roadmap for identifying partners and common interests that will enable the LACDBH to jointly seek funding.

## 7.1. Funding Sources

Adaptation strategies can be conveyed to funding agencies as a set of multiple components that can be funded either individually or as a group by a combination of local, special, state, and federal funds that address the entire vision as well as the individual components. Preliminary findings on available grant funding and financing strategies related to coastal resiliency and erosion control are presented in Table 8 to help align vulnerability analyses and adaptation pilot projects with available funding opportunities and priorities. A list of the adaptative actions considered by LACDBH that are suitable for a suite of grant opportunities is presented in Table 8.

***Table 8. Approach To Grant Applications For Adaptation Strategies***

| Proposed Adaptation Strategy | Framing for Grants | Possible Grant Opportunity |
|---|---|---|
| **Beach nourishment** | - Sand placement on the beach or in the nearshore | - DBW Shoreline Erosion Control and Public Beach Restoration<br>- USACE Continuing Authorities Program Section 103 |
| **Living Shoreline at the Beach** | - Nature-based shoreline resilience<br>- Dune system<br>- Wetland/habitat restoration | - NOAA Coastal Resilience Program<br>- State Climate Ready Program<br>- Proposition 1 and 68 (California State Coastal Conservancy, or CSCC)<br>- Ocean Protection Council |
| **Hard infrastructure improvement** | - Infrastructure resilience improvement<br>- Revetment/seawall<br>- Groins/jetties | - DBW Shoreline Erosion Control and Public Beach Restoration |
| **Sand retention strategies** | - Planting dune vegetation for sand retention<br>- Sand back-passing<br>- Sand retention (e.g., groin) | - State of Cal Climate Ready Program<br>- State Prop 68 (CSCC)<br>- Ocean Protection Council |

The State of California updated and prepared guidance and strategic documents related to climate change that guide the grant funding resources. Voters of California approved over $11.5 billion (Proposition 1 & 68) to fund drought, water, park, climate, and coastal protection projects, as well as an "outdoor access for all" program. The State of California Natural Resource Agencies are responsible for distributing the funds to projects that restore ecosystems and habitats while supporting coastal communities in anticipation of sea level rise impacts. Focusing on coastal resiliency projects that enhance the marine and wetland ecosystems, reduce greenhouse gases, provide nature-based flood-control solutions and improve fisheries will meet the intention of the Propositions. A broad suite of federal and state programs was reviewed and narrowed down to a smaller subset of prioritized agencies and their respective programs for this preliminary analysis. This prioritization was based on an assessment of the alignment of agency and funding program objectives and the County's likely competitive position to secure funds. This exercise resulted in a preliminary prioritized list of eight funding programs administered by federal and state agencies, as shown in Table 9 below.

***Table 9. Prioritized Funding Programs***

| Prioritized Funding Programs | |
|---|---|
| **Agency** | **Program** |
| California Department of Parks and Recreation<br>Division of Boating and Waterways (DBW) | Public Beach Restoration<br>Shoreline Erosion Control Program |
| Ocean Protection Council (OPC)<br>California State Coastal Conservancy (CSCC)<br>California Department of Fish and Wildlife | Climate Ready Program<br>Proposition 68<br>Proposition 1 |
| U.S. Army Corps of Engineers (USACE) | Continuing Authorities Program Section 103 |
| National Oceanic and Atmospheric Administration (NOAA) | Coastal Resilience Grants<br>Coastal Management Grants |

Findings from this preliminary analysis indicate that the California Division of Boating and Waterways (DBW) Public Beach Restoration grant program is a promising near-term funding option that provides funding for planning and implementation of beach nourishment projects. It has a history of funding projects that place sand on the beach as an adaptation strategy to offset predicted levels of erosion and sea level rise and to reduce the impacts of flooding during stormflow events, along with providing ecological restoration. The funding objectives and availability of resources for the other agencies are better aligned with projects such as living shorelines and infrastructure adaptation that generally have a longer planning time horizon and are more interdisciplinary.

## 7.2. Partnerships for Project Success

A key aspect of successful planning and implementation of resilience projects will be forming effective partnerships with diverse organizations, government agencies, and non-governmental organizations (NGOs). Many County beaches contain or are located near a wide variety of assets that serve surrounding communities, including critical roadways, bike paths, or ecological resources. The beach often serves as a buffer between these assets and potential coastal hazards, shielding transportation infrastructure or sensitive habitat areas from intense waves and currents. Forming partnerships and coordinating with organizations or agencies that manage such assets will ultimately enable more widespread, effective solutions as coastal hazards evolve over time. The list of potential local partners is listed below.

- **Heal The Bay (HTB):** HTB is a non-profit organization (NGO) and is well funded and can provide influence for LACDBH for environmental and habitat-related adaptation projects.
- **Local Government:** Local Cities can provide important political support, permits, access easements, etc. to LACDBH for project implementation. As an example, City of Los Angeles owns the rights to the seabed offshore of Playa Del Rey that possesses very high-quality sand for future beach nourishment. Any potential for dredging offshore at that location to nourish LA County beaches would require permission from the City. Partnering would be an effective way to secure the permits, and possibly enlarge the project to include other beaches if the City decides to become part of the project to receive sand on City beaches. A similar situation exists off of Venice Beach and Manhattan Beach. Expanding the project to include partners that share funding can make the project more cost-effective.
- **Santa Monica Bay Restoration Commission (SMBRC):** The commission is a non-regulatory entity established in part to coordinate, advise, and oversee the funding that affects the beneficial uses, restoration, and enhancement of Santa Monica Bay. Any nature-based resiliency project implemented within Santa Monica Bay would likely fall under this umbrella.
- **Surfrider Foundation:** The Surfrider Foundation is a highly active non-profit organization (NGO) that advocates for ocean protection, beach access, and coastal preservation through its local chapters. Initiatives are often centered on surfing locations, including past efforts at Surfrider

Beach. Surfrider is also a non-profit that wields influence and can be very helpful in gaining traction for environmental and habitat restoration adaptation projects.

- **USC Sea Grant (USCSG):** USCSG will provide geospatial mapping support to develop tools, such as Story Maps and data platforms, that provide technical assistance for communities interested in implementing natural and nature-based solutions in their own communities to further advance regional risk reduction.
- **The Bay Foundation (TBF):** TBF will lead the living shoreline dune habitat enhancement aspects of our resiliency strategy. This involves the management of subcontractors and volunteer groups in the removal of invasive plants and seeding and installation of California native coastal species as well as interpretive informational/educational signage and monitoring and adaptive management of the habitat areas.
- **Tribes:** LACDBH proposes an equitable governance structure for the project, engaging tribes whose ancestral lands cover project areas early and on an ongoing basis.

A broader list of potential local partners that are outside of the County's jurisdiction is listed below. Some of these agencies are funders while others may only be politically supportive.

- **American Shore & Beach Preservation Association (ASBPA):** ASBPA is dedicated to preserving, protecting and enhancing our coasts by merging science and public policy by advocating for healthy, sustainable and resilient coastal systems to sustain four inter-connected core values provided by shores and beaches: community protection, a strong economy, ecologic health and recreation.
- **Beach Ecology Coalition (BEC):** The BEC's mission is to enhance ecosystem conservation and beach management to balance natural resource protection and recreational use.
- **California Marine Affairs & Navigation Conference (CMANC)**: The Marine Affairs and Navigation Conference originated in San Francisco in the 1950's as a regional committee concerned with navigational civil works. It provided a common means and mechanism for regional ports, counties, and development agencies and others interested in navigational improvements, to join in seeking favorable public decisions and support of their projects.
- **Federal Agencies Including the USACE, NOAA, and USFWS:** Federal agencies are typically the last partners to join a local effort if necessary for funding and permitting. Having them onboard as partners early can help to streamline the approvals and potentially open up funding opportunities.
- The **Naval Base Ventura County Point Mugu:** This entity has jurisdiction over Mugu Submarine Canyon and any project to bypass sand into LA County needs their support.
- Southern California Coastal Water Research Project
- The **Southern California Super-Regional Collaborative:** This group is presently informal without any written agreements among members yet, and consists of LACDBH and the following partners to group together under one umbrella while approaching the State Department of Parks and Recreation for regional funding through the Shoreline Erosion Control Program and Public Beach Restoration Program:
  - San Diego Association of Governments (SANDAG)
  - Beach Erosion Authority for Clean Oceans and Nourishment (BEACON) Joint Powers Authority because Mugu Canyon is within BEACON's jurisdiction.
  - Orange County Parks
- **State and County Departments of Transportation:** Given the proximity of many County beaches to major roadways such the Pacific Coast Highway or other transportation infrastructure such as bike paths, collaboration with regional or state transportation agencies is likely to benefit coastal resilience projects. Highlighting the importance of County beaches in protecting this

infrastructure can also open up a wider array of funding opportunities. Caltrans funds projects themselves that may be available to LACDBH. One example is the eroded shoulder along the shoreline of Coast Beach just east of Topanga Point. Caltrans has barricaded the shoulder along PCH and may be highly interested in partnering on possible solutions.

- **State Coastal Conservancy (CSCC), Ocean Protection Council (OPC), Department of Fish & Wildlife, and Wildlife Conservation Board:** The State Coastal Conservancy and the Ocean Protection Council fund environmental adaptation projects. Having both as partners in support of County project ideas would increase the probability of them being funded. The County has already been in conversations with the CSCC with conversations about applying for future funding with positive signals in response.

# 8. Next Steps

Successful implementation of these proposed adaptation projects will benefit other beaches downcoast of the project site, including the remaining non-pilot LA County beaches as well as others in the region, through natural sand migration patterns. The proposed projects will strengthen future coastal resiliency across the region via synergies with similar green and gray projects led by neighboring jurisdictions. Project implementation will require:

- Engaging the community through public outreach
- Establishing partnerships with local and regional agencies and organizations
- Prioritizing projects according to risks, community needs, and funding opportunities
- Preparing concept-level engineering and feasibility studies
- Completing environmental review and permitting
- Preparing final engineering for construction
- Securing funding
- Constructing the project
- Monitoring the project for success and lessons learned

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# Attachment A1—Preliminary Draft Order of Magnitude Opinion of Probable Construction Costs for the Zuma/Pt. Dume Nourishment and Living Shoreline Concept

| | | | | | |
|---|---|---|---|---|---|
| | 8/11/2023 | | | | |
| | **PRELIMINARY DRAFT** | | | | |
| | **ORDER OF MAGNITUDE CONSTRUCTION COSTS** | | | | |
| | **Zuma Beach/Point Dume Nourishment and Living Shoreline Expansion** | | | | |
| | **LA County DBH Coastal Resilience Study** | | | | |
| **ITEM NO.** | **ITEM DESCRIPTION** | **QUANTITY** | **UNIT** | **UNIT COST** | **SUBTOTAL** |
| | **Beach Nourishment Components** | | | | |
| 1 | Mobilization & Demobilization of Earthmoving Equipment | 1 | LS. | $25,000.00 | $25,000 |
| 2 | Mobilization & Demobilization of Dredging Equipment | 1 | L.S. | $5,000,000.00 | $5,000,000 |
| 3 | Temporary Protective Construction Fence | 2,500 | LF | $3.00 | $7,500 |
| 4 | Offshore Dredging off Dockwieler Beach & Transport Onto Beach | 500,000 | CY | $40.00 | $20,000,000 |
| 5 | Grading New Sand on the Beach and Longitudinal Dikes for Turbidity | 500,000 | CY | $6.00 | $3,000,000 |
| | **Subtotal Beach Nourishment** | | | | **$28,032,500** |
| | | | | | |
| 6 | **Expand Living Shoreline Areas** | | | | |
| 7 | Install Sand Dune Fencing | 1,000 | LF | $6.00 | $6,000 |
| 8 | Remove Non-Natives (Weeding over Two Acres) | 2 | AC | $2,500.00 | $5,000 |
| 9 | Apply Dune Plant Seeds | 2,000 | EA | $0.25 | $500 |
| 10 | Install New Perimeter Fencing - Cable and Post | 2,000 | LF | $2.50 | $5,000 |
| 11 | Install Kiosk | 1 | EA | $1,000.00 | $1,000 |
| 12 | Install Signage | 4 | EA | $250.00 | $1,000 |
| | **Subtotal Expand Living Shoreline** | | | | **$18,500** |
| | | | | | |
| 13 | **Monitoring and Maintenance** | | | | |
| 14 | Pre-Construction - Beach Profiles, Grunion | 1 | LS | $50,000.00 | $50,000 |
| 15 | Construction - Grunion, Water Quality | 1 | LS | $35,000.00 | $35,000 |
| 16 | Post-Construction - Beach Profiles, Dune Plants, Weeding | 5 | YRS | $55,000.00 | $275,000 |
| | **Subtotal Monitoring** | | | | **$360,000** |
| | | | | | |
| | **Subtotal Items** | | | | **$28,411,000** |
| | | | | | |
| | Contingency of 25% | | | | $7,102,750 |
| | | | | | |
| | Planning, Environmental Review, Permitting, Design (0.25%) | 1 | EA | | $887,844 |
| | Construction Support Services (0.0625%) | 1 | EA | | $221,961 |
| | Construction Management (0.125%) | 1 | EA | | $443,922 |
| | Inspection, Survey, and Administration (0.0625%) | 1 | EA | | $221,961 |
| | | | | | |
| | **Grand Total** | | | | **$37,289,438** |
| | | | | | |
| | ASSUMPTIONS: | | | | |
| 1 | Contractor stages at entire south end from restrooms to Point. | | | | |
| 2 | No construction fencing needed at living shoreline location. | | | | |

# Attachment A2—Preliminary Draft Order of Magnitude Opinion of Probable Construction Costs for the Dockweiler Project Concept

| | | | | | |
|---|---|---|---|---|---|
| | 8/11/2023 | | | | |
| | **PRELIMINARY DRAFT** | | | | |
| | **ORDER OF MAGNITUDE CONSTRUCTION COSTS** | | | | |
| | **Dockweiler Sand Management** | | | | |
| | **LA County DBH Coastal Resilience Study** | | | | |
| **ITEM NO.** | **ITEM DESCRIPTION** | **QUANTITY** | **UNIT** | **UNIT COST** | **SUBTOTAL** |
| | **Beach Nourishment Components - None Included** | | | | |
| 1 | Mobilization & Demobilization of Earthmoving Equipment | 0 | LS. | $25,000.00 | $0 |
| 2 | Mobilization & Demobilization of Dredging Equipment | 0 | L.S. | $2,500,000.00 | $0 |
| 3 | Temporary Protective Construction Fence | 0 | LF | $3.00 | $0 |
| 4 | Offshore Dredging off Dockwieler Beach & Transport | 0 | CY | $20.00 | $0 |
| 5 | Nourishment at the Beach Behind the Breakwater | 0 | CY | $6.00 | $0 |
| | **Subtotal Beach Nourishment** | | | | **$0** |
| | **Offshore Breakwater Components - Not Included** | | | | |
| 6 | Mob/Demob/Prep Work | 0 | LS. | $300,000.00 | $0 |
| 7 | Armor Layer | 0 | Tons | $110.00 | $0 |
| 8 | Underlayer | 0 | Tons | $86.00 | $0 |
| | **Subtotal Offshore Breakwater** | | | | **$0** |
| | **Expand Living Shoreline Area Components** | | | | |
| 9 | Install Sand Dune Fencing | 1,000 | LF | $6.00 | $6,000 |
| 10 | Remove Non-Natives (Weeding over Two Acres) | 3 | AC | $2,500.00 | $7,500 |
| 11 | Apply Dune Plant Seeds | 3,000 | EA | $0.25 | $750 |
| 12 | Install New Perimeter Fencing - Cable and Post | 2,200 | LF | $2.50 | $5,500 |
| 13 | Install Kiosk | 1 | EA | $1,000.00 | $1,000 |
| 14 | Install Signage | 4 | EA | $250.00 | $1,000 |
| | **Subtotal Expand Living Shoreline** | | | | **$21,750** |
| | **Sand Barrier Wall Components** | | | | |
| 15 | Mobilization | 1 | LS | $10,000.00 | $10,000 |
| 16 | Footing | 1,120 | LF | $500.00 | $560,000 |
| 17 | Wall Installation | 1,120 | LF | $1,000.00 | $1,120,000 |
| 18 | Sculpting | 1,120 | LF | $50.00 | $56,000 |
| | **Subtotal Sand Barrier Wall** | | | | **$1,746,000** |
| | **Monitoring and Maintenance** | | | | |
| 19 | Pre-Construction - Snowy Plovers | 1 | LS | $10,000.00 | $10,000 |
| 20 | Construction - Snowy Plovers | 1 | LS | $10,000.00 | $10,000 |
| 21 | Post-Construction - Dune Plants, Weeding | 1 | LS | $10,000.00 | $10,000 |
| | **Subtotal Monitoring** | | | | **$30,000** |
| | **Subtotal Items** | | | | **$1,797,750** |
| | Contingency of 25% | | | | $449,438 |
| | Planning, Environmental Review, Permitting, Design (1.5%) | 1 | EA | | $337,078 |
| | Construction Support Services (0.25%) | 1 | EA | | $56,180 |
| | Construction Management (0.5%) | 1 | EA | | $112,359 |
| | Inspection, Survey, and Administration (0.25%) | 1 | EA | | $56,180 |
| | **Grand Total** | | | | **$2,808,984** |
| | ASSUMPTIONS: | | | | |
| 1 | Contractor stages at parking lot. | | | | |
| 2 | No construction fencing needed at living shoreline location. | | | | |

# Attachment A3—Preliminary Draft Order of Magnitude Opinion of Probable Construction Costs for the South Redondo Beach Project Concept

| | | | | | |
|---|---|---|---|---|---|
| | 8/11/2023; Revised 9/29/23 | | | | |
| | **PRELIMINARY DRAFT** | | | | |
| | **ORDER OF MAGNITUDE CONSTRUCTION COSTS** | | | | |
| | **Redondo Beach Nourishment & Retention With Living Shoreline** | | | | |
| | **LA County DBH Coastal Resilience Study** | | | | |
| **ITEM NO.** | **ITEM DESCRIPTION** | **QUANTITY** | **UNIT** | **UNIT COST** | **SUBTOTAL** |
| | **Beach Nourishment Components** | | | | |
| 1 | Mobilization & Demobilization of Earthmoving Equipment | 1 | LS. | $25,000.00 | $25,000 |
| 2 | Mobilization & Demobilization of Dredging Equipment | 1 | L.S. | $5,000,000.00 | $5,000,000 |
| 3 | Temporary Protective Construction Fence | 2,500 | LF | $3.00 | $7,500 |
| 4 | Offshore Dredging off Dockwieler Beach & Transport Onto Beach | 315,000 | CY | $30.00 | $9,450,000 |
| 5 | Grading New Sand on the Beach and Longitudinal Dikes for Turbidity | 315,000 | CY | $6.00 | $1,890,000 |
| | **Subtotal Beach Nourishment** | | | | **$16,372,500** |
| | **Pier Groin Components** | | | | |
| 6 | Mob/Demob/Prep Work | 1 | LS. | $1,000,000.00 | $1,000,000 |
| 7 | Groin Installation (520 feet long) in 2004 dollars | 520 | LF | $2,667.00 | $1,386,840 |
| 8 | Escalation from 2004 to 2030 | 1 | LS. | 78% | $1,081,735 |
| 9 | Econcrete Covering | 10,400 | SF | $ 20.00 | $208,000 |
| | **Subtotal Pier Groin** | | | | **$3,676,575** |
| | **Create Living Shoreline Area** | | | | |
| 9 | Install Sand Dune Fencing | 1,000 | LF | $6.00 | $6,000 |
| 10 | Remove Non-Natives (Weeding over Two Acres) | 2 | AC | $2,500.00 | $5,000 |
| 11 | Apply Dune Plant Seeds | 1,000 | EA | $0.25 | $250 |
| 12 | Install New Perimeter Fencing - Cable and Post | 2,000 | LF | $2.50 | $5,000 |
| 13 | Install Kiosk | 1 | EA | $1,000.00 | $1,000 |
| 14 | Install Signage | 4 | EA | $250.00 | $1,000 |
| | **Subtotal Expand Living Shoreline** | | | | **$18,250** |
| 15 | **Monitoring and Maintenance** | | | | |
| 16 | Pre-Construction - Beach Profiles, Grunion | 1 | LS | $50,000.00 | $50,000 |
| 17 | Construction - Grunion, Water Quality | 1 | LS | $35,000.00 | $35,000 |
| 18 | Post-Construction - Beach Profiles, Dune Plants, Weeding | 5 | YRS | $55,000.00 | $275,000 |
| | **Subtotal Monitoring** | | | | **$360,000** |
| | **Subtotal Items** | | | | **$20,427,325** |
| | Contingency of 25% | | | | $5,106,831 |
| | Planning, Environmental Review, Permitting, Design (0.25%) | 1 | EA | | $638,354 |
| | Construction Support Services (0.0625%) | 1 | EA | | $159,588 |
| | Construction Management (0.125%) | 1 | EA | | $319,177 |
| | Inspection, Survey, and Administration (0.0625%) | 1 | EA | | $159,588 |
| | **Grand Total** | | | | **$26,810,864** |
| | ASSUMPTIONS: | | | | |
| 1 | Contractor stages at parking lot. | | | | |
| 2 | No construction fencing needed at living shoreline location. | | | | |

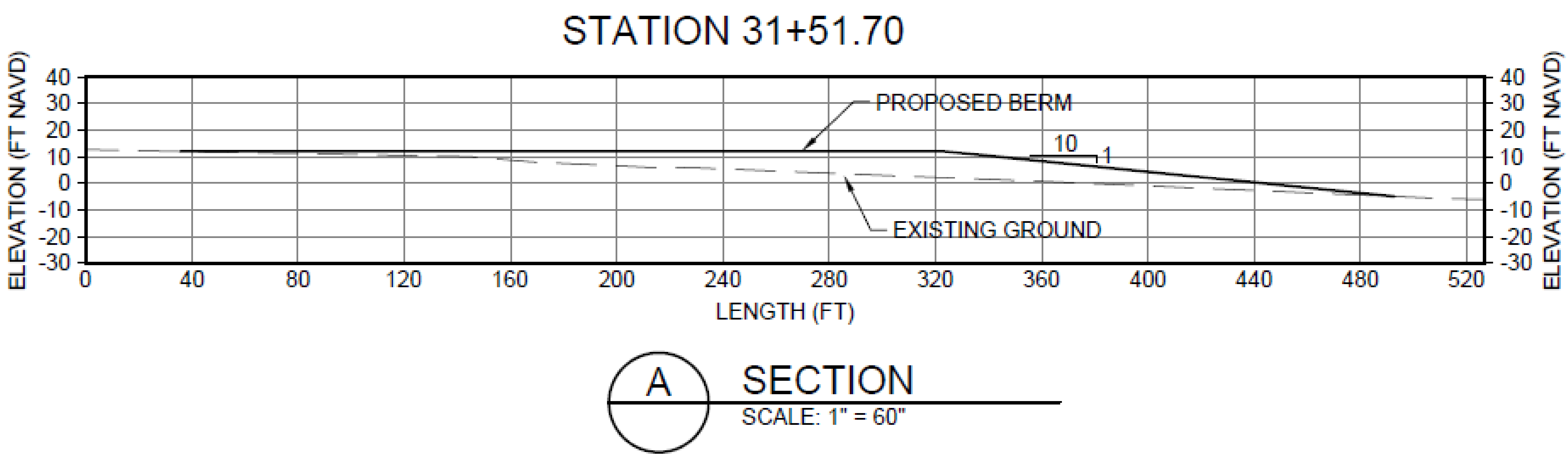
# Attachment B1—Preliminary Engineering Design Plans and Cross-Sections For The Project Concept at Zuma/Point Dume Beach


LEGEND

PROPOSED FILL

NOTES

1. TOPOGRAPHIC SOURCE: 2009 USACE NATIONAL COASTAL MAPPING PROGRAM. DATES FLOWN:SEPTEMBER 28, 2009 - OCTOBER 28, 2009)
2. CONTOUR INTERVAL = 1 FOOT.
3. CONTOUR ELEVATIONS ARE IN REFERENCE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
4. FILL VOLUME IS APPROXIMATELY 509,000 CUBIC YARDS.


STATION 31+51.70
PROPOSED BERM
10
1
EXISTING GROUND
ELEVATION (FT NAVD)
40
30
20
10
0
-10
-20
-30
0
40
80
120
160
200
240
280
320
360
400
440
480
520
LENGTH (FT)
A
SECTION
SCALE: 1" = 60"

# Attachment B2—Preliminary Engineering Design Plans and Cross-Sections for the Project Concept at South Redondo Beach


<u>LEGEND</u>

PROPOSED FILL

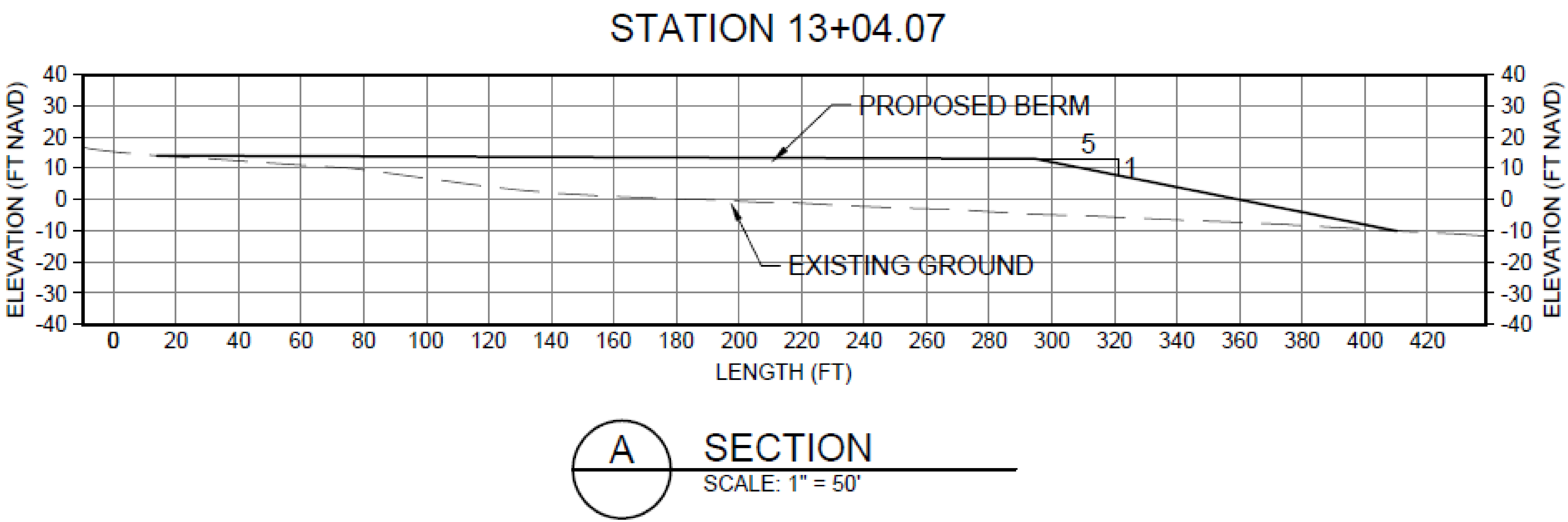
<u>NOTES</u>

1. TOPOGRAPHIC SOURCE: 2014 USACE NATIONAL COASTAL MAPPING PROGRAM. DATES FLOWN:SEPTEMBER 8, 2014 - OCTOBER 5, 2014)
2. CONTOUR INTERVAL = 1 FOOT.
3. CONTOUR ELEVATIONS ARE IN REFERENCE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
4. FILL VOLUME IS APPROXIMATELY 316,000 CUBIC YARDS

N

100' 0' 100' 200'

Scale: 1"=100'


STATION 13+04.07
PROPOSED BERM
5
1
EXISTING GROUND
ELEVATION (FT NAVD)
LENGTH (FT)
40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
A
SECTION
SCALE: 1" = 50'

# Attachment C—Economic Study by Ceto

**Los Angeles County Beach Nourishment**

**Recreational Economic Impact Assessment**

November 17, 2023

## METHODS

### *Valuing Beach Recreation*

In California, all beaches below the mean high tide and are considered public property; under the California Coast Act[1] beaches cannot be bought or sold in California. As a result, a market price cannot be established for beach access, recreation, and visitation. In addition, since everyone in California has access to beaches, there is no admission price to base visit value on, although many beaches do charge for parking in official beach parking lots[2]. Despite the lack of admission price, or additional cost for (most) public amenities, beaches have a non-market value to the public. Economists determine non-market value by estimating what consumers would be willing to pay (WTP) for access to the resource. .

For beach recreation, this study applies a use value of $62 per person, per day based on a meta analysis of studies estimating the non-market value of beaches in California in terms of WTP. This value is consistent with a recent case before the Coastal Commission in Solana Beach and previous reports, updated for current inflation. To estimate the total value of beach recreation, the WTP day use value ($62) is multiplied by the number of visitors. For example, if a beach has 100,000 annual visitors, the value of beach recreation is $\$62 \times 100,000 = \$6.2\ million$[3]

### *Economic Analysis and the Future*

This analysis uses real 2023 dollars for all estimates. Effectively, this assumption implies that the relative value will remain the same over time—that is, the inflation rate for all goods and services will be the same. However, it is likely that some costs and prices will rise faster than others while product innovation may lower the relative prices of other goods and services.

As is standard in an economic benefit/cost analysis, future costs and benefits must be discounted—future benefits/costs are worth less than the same benefit/costs today. The choice of discount rate is critical in any benefit/cost analysis. When considering capital investments (e.g., financing a seawall) one

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[1] CA Pub. Res. Code § 3000

[2] Zuma Beach charges $0.25 per 10 minutes for up to 90 minutes, or a maximum of $2.25. https://www.zuma-beach.com/parking.html

[3] See Pendleton, L., Kildow, J. and Rote, J.W., 2006. The non-market value of beach recreation in California. *Shore and Beach*, *74*(2), p.34., and King, P., A. McGregor and J. Whittet. 2015. Can California Coastal Managers Plan for C.E., 2012. Collecting and Using Economic Information to Guide the Management of Coastal Recreational Sea-Level Rise in a Cost-Effective Way. Journal of Environmental Planning and Management., and Nelsen, Resources in California. University of California, Los Angeles.

should consider the cost of capital—what it actually costs to borrow the necessary funds to finance a project. Currently, short- and long-term interest rates are relatively low, and the cost of financing a project through Federal, State, or local bonds is in the 3% to 5% range. However, even a relatively low discount rate can imply that benefits and costs for future generations are valued far less than current benefits. Many economists have argued that the social discount rate should be lower than the market cost of capital. This study estimates benefits and costs utilizing a 3% future discount rate as well as an undiscounted, or zero-discount, rate.

### *Carrying Capacity and Turnover Rate*

Having a standard approximation for the value of a beach trip allows city planners and researchers to understand the value of existing patterns of beach recreation and attendance. Applying this methodology to the future of California's beaches, however, requires additional calculations to consider changing conditions. Fundamentally, estimating the impact of sea level rise on the recreational value of beaches depends on the impact sea level rise has on beach attendance.

As sea levels rise, beaches will either migrate landward with the rising water if the back beach is unconstrained, or, when constrained, narrow and erode. The loss of beach attendance as a result of reduced beach width can be modeled using the *carrying capacity* of a given beach. In this study, carrying capacity is defined as the maximum occupancy–the number of visitors a beach can accommodate given the usable area of a sandy beach, or "towel space". While visitors do not tend to explicitly assess a beach in terms of its carrying capacity, they do make decisions and alter their visiting behavior based on how *crowded* a beach appears. When a beach becomes too crowded, and people choose to go elsewhere or not to visit, the carrying capacity has been exceeded.

Observational data indicated that visitors do not choose to occupy beach areas adjacent to the parking lots, seawalls, or other infrastructure. Thus, a 50-foot buffer was employed when calculating the beach area (beach length x beach width) to account for the undesirable areas of the beach. It is assumed that beachgoers generally require about 100 $ft^2$ of "towel space." Given that beach goers do not typically spend the entire day at the beach, a turnover rate (the rate at which visitors leave and are replaced) is applied. While this rate may vary from beach to beach, this analysis and several previous analyses utilize the rate of 1.6 calculated by King & McGregor (2012) for California's beaches. This rate assumes the average visitor spends just over half a day at the beach. Thus, to calculate the carrying capacity for a given beach, the area of site is divided by the required "towel space" and multiplied by the turnover rate (eq. 1).[4]

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[4] See and King, P. and McGregor, A. 2012. "Who's counting: An analysis of beach attendance estimates and methodologies in southern California." Ocean & Coastal Management, 10.1016/j.ocecoaman.2011.12.005, 17-25.

$$Carrying\ Capacity = \frac{Beach\ Length\ x\ (Beach\ Width - Buffer)}{Average\ "Towel\ Space"} \times Turnover\ Rate$$

or

$$Carrying\ Capacity = \frac{Beach\ Length\ (ft)\ x\ (Beach\ Width - 50\ ft)}{100\ ft^2}\ 1.6$$

(EQ. 1)

Because daily attendance is rarely equivalent to carrying capacity, with the exception of the most popular beaches during peak season, when assessing the effects changing beach width on attendance it is helpful to understand the current utilization rate at a given beach. The utilization rate measures how closely the daily visitation aligns with the carrying capacity of the beach.

Most beach visitation is seasonal, with more than half of all visits taking place in the summer high season (June-August). Thus, a loss of sandy beach area would impact the summer attendance (peak season) far more than the rest of the months, when the utilization rate is highest. It should also be noted that sandy beaches tend to be wider in the summer months and narrower during the winter months as a result of the seasonal variation in wave energy and direction. Based on these fluctuations in attendance, beaches have a high utilization rate in the summer and a low utilization rate in winter.

## Zuma Beach

### *No Nourishment*

This analysis assumes Zuma Beach will erode by 25 feet over the 8-year life of the project without erosion. Given that the beach is already narrow (125 feet), with 75 feet width of desirable "towel space," a 25 ft reduction in beach width would significantly impact its carrying capacity, particularly in the summer high season.

Official Los Angeles County attendance data for the period from 2018 to 2022 indicates that Zuma beach receives on average two million visitors a year, with 135 days per year already exceeding the calculated carrying capacity (Table 1); indicating that this beach is currently too narrow to meet the demand. jJust over one-third of all beach days (37%) at Zuma Beach are currently over-capacity. Zuma beach is especially vulnerable to the effects of coastal erosion. Projected erosion of 3.7 feet per year over the next eight years will result in 47% (172 days) of the year with Zuma exceeding carrying capacity. Narrowing the period of analysis to just the high season (June, July, and August), carrying capacity is currently exceeded 90% of the time (82 days), and will increase to 92% of the time (84 days) over the next eight years (Table 1).

**Table 1: Number of Days per Year Zuma Beach Exceeds Carrying Capacity: Current Conditions**

| FULL YEAR | | | | |
|---|---|---|---|---|
| YEAR | FULL YEAR # DAYS PER YR CAPACITY IS EXCEEDED | FULL YEAR % CAPACITY IS EXCEEDED | HIGH SEASON # DAYS PER YR CAPACITY IS EXCEEDED | HIGH SEASON % CAPACITY IS EXCEEDED |
| 1 | 135 | 37% | 82 | 90% |
| 2 | 141 | 39% | 82 | 90% |
| 3 | 146 | 40% | 82 | 91% |
| 4 | 151 | 41% | 83 | 91% |
| 5 | 156 | 43% | 83 | 91% |
| 6 | 162 | 44% | 83 | 91% |
| 7 | 167 | 46% | 83 | 92% |
| 8 | 172 | 47% | 84 | 92% |
| Total | 1229 | | 662 | |

On Zuma beach, a loss in beach width resulting in a loss of carrying capacity has a non-market value (Table 2). Considering all visitation over the carrying capacity as“lost” non market value, the resulting loss is substantial, starting at $105 million in the first year and increasing over time to $127 in the eighth year. The cumulative losses over the eight years assessed would be close to $927 million dollars. Applying the 3% discount drops the non market value loss (NMV) cumulative value to $834 million (Table 2).

**Table 2: Zuma Beach: Loss in Non-Market Value**

| FULL YEAR | | | |
|---|---|---|---|
| YEAR | PROJECTED # OF PERSONS OVER CAPACITY PER YEAR | LOST NON-MARKET VALUE PER YEAR | DISCOUNTED LOST NON-MARKET VALUE PER YEAR |
| 1 | 1,683,283 | $104,363,567 | $104,363,567 |
| 2 | 1,736,306 | $107,650,944 | $104,515,480 |
| 3 | 1,789,328 | $110,938,322 | $104,570,009 |
| 4 | 1,842,350 | $114,225,700 | $104,532,697 |
| 5 | 1,895,372 | $117,513,078 | $104,408,848 |
| 6 | 1,948,394 | $120,800,456 | $104,203,534 |
| 7 | 2,001,417 | $124,087,833 | $103,921,607 |
| 8 | 2,054,439 | $127,375,211 | $103,567,703 |
| Total | 14,950,889 | $926,955,111 | $834,083,444 |

### *Nourishment: 500,000 cubic yards*

The first proposed beach nourishment project would add 500,000 cubic yards of sand to Zuma Beach, extending its useful width by 25 feet. Although 25 feet may sound like a small amount, this width has a significant impact on the carrying capacity of a narrow beachlike Zuma. At Zuma Beach, placing sand for an additional 25 feet of width will substantially increase the carrying capacity of the beach, essentially offsetting eight years of projected erosion. With nourishment, the number of days where attendance exceeds the carrying capacity is reduced by 5% to 10% annually, to between 32% and 37% over the project life. Concentrating this analysis to only the peak, high season months, the percentage of days exceeding carrying capacity falls from 90% to 87% in the first year, before returning to 90% in the seventh and eighth year (Table 3), a reduction in the percentage of days over capacity without the additional sand (Table 2). When accounting for the NMV of a beach user, adding 25 feet of additional beach width lowers the loss in non-market value from $926 million to $758 million, a gain of $167 million in non-market value; or $136 million considering the 3% discount rate.

**Table 3: Number of Days per Year Zuma Beach Exceeds Carrying Capacity**

| FULL YEAR | | | | |
|---|---|---|---|---|
| YEAR | FULL YEAR # DAYS PER YR CAPACITY IS EXCEEDED | FULL YEAR % CAPACITY IS EXCEEDED | HIGH SEASON # DAYS PER YR CAPACITY IS EXCEEDED | HIGH SEASON % CAPACITY IS EXCEEDED |
| 1 | 115 | 32% | 79 | 87% |
| 2 | 117 | 32% | 79 | 87% |
| 3 | 120 | 33% | 80 | 88% |
| 4 | 123 | 34% | 80 | 88% |
| 5 | 126 | 35% | 81 | 89% |
| 6 | 129 | 35% | 81 | 89% |
| 7 | 132 | 36% | 82 | 90% |
| 8 | 135 | 37% | 82 | 90% |
| Total | 999 | | 644 | |

**Table 4: Zuma Beach: Loss in Non-Market Value with 500,000 cy Nourishment**

| FULL YEAR | | | |
|---|---|---|---|
| YEAR | PROJECTED # OF PERSONS OVER CAPACITY PER YEAR | LOST NON-MARKET VALUE PER YEAR | DISCOUNTED LOST NON-MARKET VALUE PER YEAR |
| 1 | 1,379,467 | $85,526,933 | $85,526,933 |
| 2 | 1,422,869 | $88,217,881 | $85,648,428 |
| 3 | 1,466,271 | $90,908,829 | $85,690,290 |
| 4 | 1,509,674 | $93,599,776 | $85,657,054 |
| 5 | 1,553,076 | $96,290,724 | $85,553,061 |
| 6 | 1,596,479 | $98,981,671 | $85,382,459 |
| 7 | 1,639,881 | $101,672,619 | $85,149,218 |
| 8 | 1,683,283 | $104,363,567 | $84,857,130 |
| Total | 12,251,000 | 759,562,000 | 683,464,574 |

### *Nourishment: 1,000,000 cubic yards*

The second beach nourishment project proposal doubles the amount of nourishment to 1,000,000 cubic yards of sand. Doubling the volume of sand does not double the project cost as some costs are "fixed," in particular the costs of a hopper dredge. Based on past experience, this assessment assumes that 20% of the $37 million in costs are fixed, therefore doubling the volume only increases the cost by 80%, to just over $67 million.

Increasing the volume of sand increases the beach width and thus, the carrying capacity of Zuma Beach. While most high season days are still crowded, the loss in non-market value is reduced to $621 million over the project lifetime, or $558 million when using the discounted rate. With this proposed plan, the lost non-market value is reduced by $306 million, or $249 million discounted, over the project's eight year expected lifespan (Tables 5 and 6).

**Table 5: Number of Days per Year Zuma Beach Exceeds Carrying Capacity: 1,000 CY Nourishment**

| FULL YEAR | | | | |
|---|---|---|---|---|
| YEAR | FULL YEAR # DAYS PER YR CAPACITY IS EXCEEDED | FULL YEAR % CAPACITY IS EXCEEDED | HIGH SEASON # DAYS PER YR CAPACITY IS EXCEEDED | HIGH SEASON % CAPACITY IS EXCEEDED |
| 1 | 97 | 27% | 75 | 82% |
| 2 | 102 | 28% | 76 | 84% |
| 3 | 108 | 30% | 77 | 85% |
| 4 | 113 | 31% | 78 | 86% |
| 5 | 119 | 33% | 79 | 87% |
| 6 | 124 | 34% | 80 | 88% |
| 7 | 130 | 36% | 81 | 89% |
| 8 | 135 | 37% | 82 | 90% |
| Total | 927 | | 628 | |

**Table 6: Zuma Beach: Loss in Non-Market Value with 1000,000 cy Nourishment**

| FULL YEAR | | | |
|---|---|---|---|
| YEAR | PROJECTED # OF PERSONS OVER CAPACITY PER YEAR | LOST NON-MARKET VALUE PER YEAR | DISCOUNTED LOST NON-MARKET VALUE PER YEAR |
| 1 | 1,125,644 | $69,789,956 | $69,789,956 |
| 2 | 1,161,905 | $72,038,095 | $69,939,898 |
| 3 | 1,198,165 | $74,286,235 | $70,021,901 |
| 4 | 1,234,425 | $76,534,375 | $70,039,795 |
| 5 | 1,270,686 | $78,782,514 | $69,997,243 |
| 6 | 1,306,946 | $81,030,654 | $69,897,754 |
| 7 | 1,343,206 | $83,278,794 | $69,744,679 |
| 8 | 1,379,467 | $85,526,933 | $69,541,223 |
| Total | 10,020,444 | 621,267,556 | 558,972,450 |

## *Benefits vs Costs*

The project engineers estimate the cost of the 500,000 cubic yard nourishment at $37,289,000. The benefit-cost analysis, assumes that 20% of total costs are fixed costs, while all other costs reflected the volume increase for the 1,000,000 cubic yard nourishment and , resulting in expected costs of $67,120,000. For both of these projects, the benefits exceed the costs at a ratio of 3.65 and 3.7 for the 500,000 cubic yard and 1,000,000 cubic yard proposals respectively (Table 7). With benefits outweighing the costs by a factor of 3,both proposals are excellent options for Zuma Beach.

**Table 7: Zuma Beach: Benefits vs Costs**

| Alternative | Avoided Lost NVM | Present Value Avoided Lost NVM | Cost | PV Net Benefits | Benefit/Cost Ratio |
|---|---|---|---|---|---|
| 500 cy Nourishment | $ 167,393,111 | $ 136,105,917 | $37,289,000 | $ 98,816,917 | 3.65 |
| 1m cy Nourishment | $ 305,687,555 | $ 248,551,956 | $74,578,000 | $ 248,551,956 | 3.33 |

## Redondo Beach

### *No Nourishment*

Despite being significantly smaller than Zuma Beach, Redondo Beach receives an average of 1.5 million visits per year according to official counts by LA Beaches and Harbors. Currently just under half of all beach days are over capacity. During the high season (June, July, and August), visitors exceed capacity on 64% of days, which indicates that Redondo Beach is less seasonal than Zuma Beach.

Redondo is currently eroding at a very slow rate, estimated at 0.5 feet per year, or 4 feet over the 8 year life of the project. However, even with no erosion, Redondo Beach is already over-capacity on many summer days without additional beach width. Table 8 presents the current situation. Currently, Redondo has almost 300,000 visitors "over capacity." As Redondo erodes over the 12 year life of the project, this carrying capacity is reduced; by year 12 over 750,000 visitors per year are over capacity. The cumulative discounted loss in non market value over the 12 year life of the project is $285 million.

**Table 8: Redondo Beach: Loss in Non-Market Value under Current Conditions**

| FULL YEAR | | | |
|---|---|---|---|
| YEAR | PROJECTED # OF PERSONS OVER CAPACITY PER YEAR | LOST NON-MARKET VALUE PER YEAR | DISCOUNTED LOST NON-MARKET VALUE PER YEAR |
| 1 | 297,026 | $18,415,632 | $18,415,632 |
| 2 | 339,546 | $21,051,839 | $20,438,679 |
| 3 | 382,065 | $23,688,047 | $22,328,256 |
| 4 | 424,585 | $26,324,255 | $24,090,422 |
| 5 | 467,104 | $28,960,462 | $25,730,996 |
| 6 | 509,624 | $31,596,670 | $27,255,565 |
| 7 | 552,143 | $34,232,878 | $28,669,496 |
| 8 | 594,663 | $36,869,085 | $29,977,940 |
| 9 | 637,182 | $39,505,293 | $31,185,843 |
| 10 | 679,702 | $42,141,501 | $32,297,951 |
| 11 | 722,221 | $44,777,709 | $33,318,820 |
| 12 | 764,741 | $47,413,916 | $34,252,822 |
| Total | 6,370,601 | 394,977,288 | 327,962,424 |

## *Nourishment*

The proposed nourishment project would add an additional 129 feet to the current beach width. With the current erosion rate of 0.5 ft per year, the lifespan of this project is estimated to be 12 years. Table 10 below indicates that with nourishment the number of days in which carrying capacity is exceeded drops significantly in both low and high seasons.

**Table 9: Redondo Beach: Loss in Non-Market Value with Nourishment**

| FULL YEAR | | | |
|---|---|---|---|
| YEAR | PROJECTED # OF PERSONS OVER CAPACITY PER YEAR | LOST NON-MARKET VALUE PER YEAR | DISCOUNTED LOST NON-MARKET VALUE PER YEAR |
| 1 | 297,026 | $18,415,632 | $18,415,632 |
| 2 | 297,026 | $18,415,632 | $17,879,254 |
| 3 | 297,026 | $18,415,632 | $17,358,499 |
| 4 | 297,026 | $18,415,632 | $16,852,912 |
| 5 | 297,026 | $18,415,632 | $16,362,050 |
| 6 | 297,026 | $18,415,632 | $15,885,486 |
| 7 | 297,026 | $18,415,632 | $15,422,802 |
| 8 | 297,026 | $18,415,632 | $14,973,594 |
| 9 | 297,026 | $18,415,632 | $14,537,470 |
| 10 | 297,026 | $18,415,632 | $14,114,048 |
| 11 | 297,026 | $18,415,632 | $13,702,959 |
| 12 | 297,026 | $18,415,632 | $13,303,844 |
| Total | 3,564,316 | 220,987,581 | 188,808,550 |

## *Benefits vs Costs*

Nourishment substantially reduces the losses in the number of days capacity is exceeded and the loss in non-market value.   The benefits vs. costs analysis for nourishment at Redondo Beach results in a benefit cost ratio of 4.69 over the expected life of the project with net benefits close to 100 million dollars in non-market value.

**Table 10:  Redondo Beach: Benefits vs Costs**

| Alternative | Avoided Lost NVM | Present Value Avoided Lost NVM | Cost | PV Net Benefits | Alternative |
|---|---|---|---|---|---|
| Nourishment | $173,989,707 | $125,693,866 | $26,810,864 | $ 98,883,002 | 4.69 |

## DISCUSSION

Our analysis indicates that all these nourishment projects can be justified based on the benefits vs cost ratio. Indeed, all three of these benefit/cost ratios are **much** greater than one, indicating that the results are likely robust with respect to any assumptions. Moreover, the analysis did not account for any benefits from reducing damages to the parking lot or highway 1 behind Zuma beach, and the erosion rate at Redondo post nourishment is highly conservative. Considering infrastructure impacts or reducing the expected post-nourishment erosion rate would increase the benefit/cost ratio.

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