CALIFORNIA COASTAL COMMISSION
SAN DIEGO AREA
7575 METROPOLITAN DRIVE, SUITE 103
SAN DIEGO, CA 92108-4421
(619) 767-2370

Th20b

6-18-1089 (CALIFORNIA DEPARTMENT OF PARKS AND RECREATION)

JUNE, 2019

EXHIBITS

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Vicinity Map A – San Onofre State Beach, San Diego County

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APPLICATION NO. **6-18-1089**
Vicinity Map
California Coastal Commission

Vicinity Map B – Surf Beach Study Area

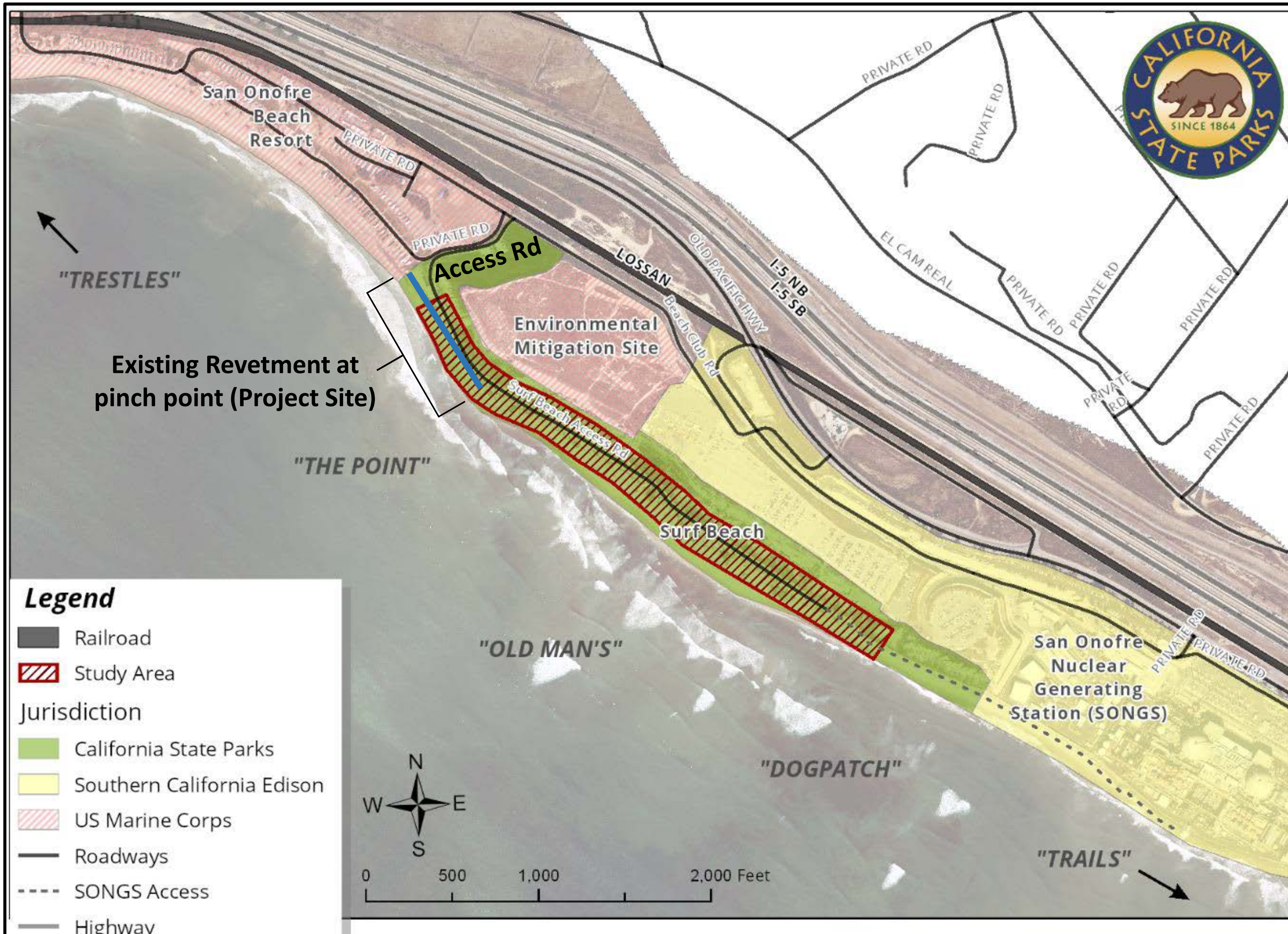

EXHIBIT NO. 2
APPLICATION NO.
6-18-1089
Aerial View
California Coastal Commission

EXHIBIT NO. 3
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Before revetment placement

EXHIBIT NO. 4
APPLICATION NO.
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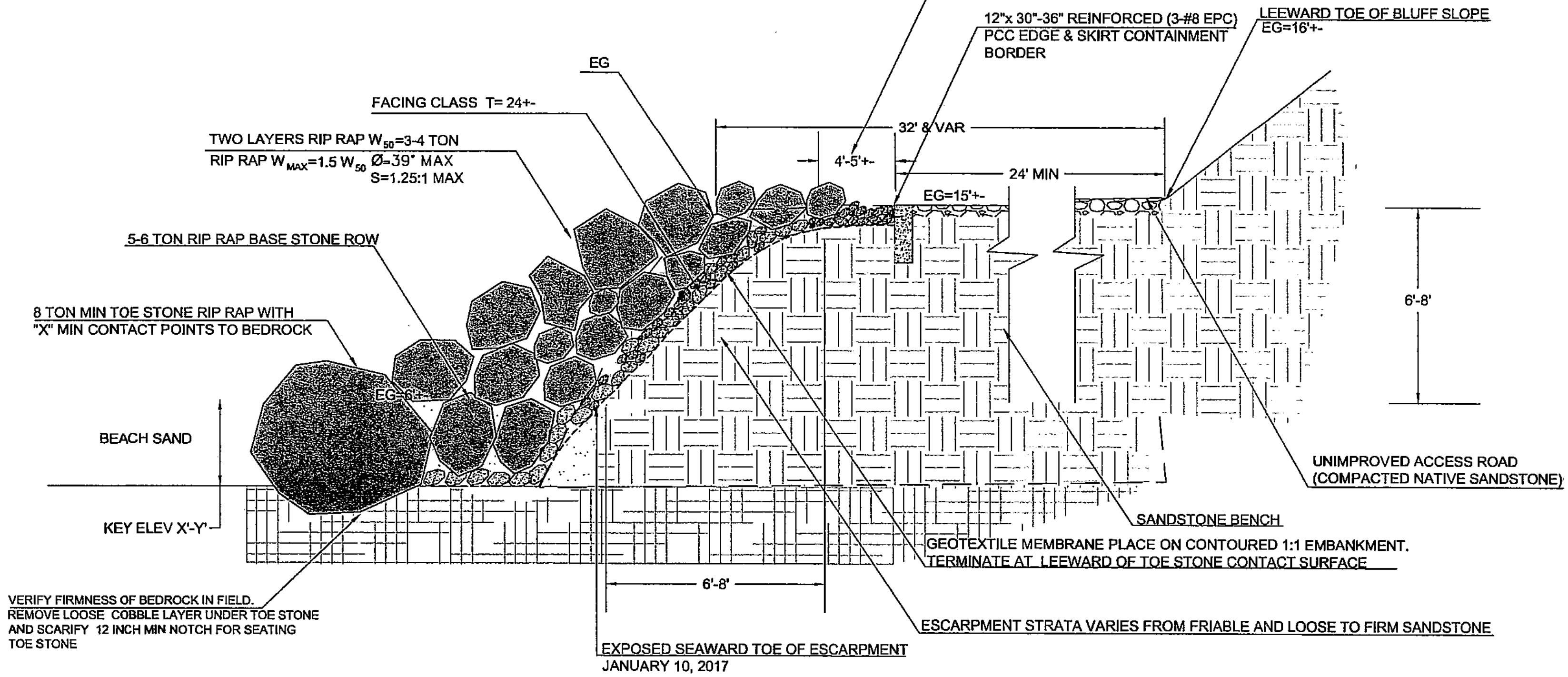
Site Photos
California Coastal Commission


access road
parking
revetment
northern park area - looking south


Access road
pinch point
revetment
northern park area - looking north


Restroom facilities
Parking and access road
Unarmored park area south of revetment
middle park area - looking north



MATERIAL QUANTITIES

8 to 10 TON STONE	____ TONS
½ to 6 TON STONE	____ TONS
FACING CLASS BACKING	____ TONS

TYPICAL SECTION

NTS

CALIFORNIA STATE PARKS SINCE 1864

ACQUISITION & DEVELOPMENT DIVISION
One Capitol Mall
Sacramento, CA
95814-3229

DESIGNED:
DRAWN: R.ROBINSON
CHECKED:
DATE: 1-13-2017

REVISIONS DATE

SAN ONOFRE STATE BEACH
SURF BEACH ACCESS ROAD

EMERGENCY REPAIR

SHEET NO.
C-2.1
1 OF 1

EXHIBIT NO. 5
APPLICATION NO.
6-18-1089
Revetment Elevation
California Coastal Commission

SAN ONOFRE STATE BEACH: SURF BEACH

LONG-TERM SHORELINE MANAGEMENT ALTERNATIVES ANALYSIS REPORT

October 2018

Prepared for:

California Department of Parks and Recreation
Orange Coast District

Prepared by:

moffatt & nichol

3780 Kilroy Airport Way, Suite 600
Long Beach, CA 90806

M&N Job No. 9280-S6

EXHIBIT NO. 6
APPLICATION NO.
6-18-1089
Long-Term Hazards Management Plan
California Coastal Commission

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1. Purpose And Scope ("Project")

Surf Beach is a part of San Onofre State Beach, a California state park unit at the Orange / San Diego county line in southern California. Surf Beach is a public day-use area, known especially for its surf break. The State Beach has been subjected to ongoing shoreline erosion which jeopardizes the park's amenities, including the access road, parking area, and restroom facilities. The purpose of this study is to identify and assess potential long-term management alternatives for Surf Beach to provide resiliency for coastal hazards such as erosion, sea level rise, and storm events.

The management alternatives are intended to provide long-term protection at Surf Beach for coastal access, public opportunities for coastal recreation, and biological resources. This report provides a coastal engineering assessment of the potential causes of current erosion problems so that appropriate responses can be developed. The study investigates physical changes related to the shoreline, littoral sediment transport, and existing and future oceanographic conditions to address State Parks facilities protection and beach preservation.

The following are included in this report:

- Current site conditions, including existing biological resources;
- Relevant State policies;
- Coastal hazards assessment;
- Conceptual drawings of each potential alternative;
- Qualitative assessments of each potential alternative;
- Preliminary opinions of probable construction cost for each alternative;
- Identification of habitat constraints associated with each alternative;
- Evaluation of each alternative's potential impacts on public access, recreation (including surfing) and adjacent shorelines;
- Permitting/CEQA considerations
- Long-term maintenance needs; and
- A recommended long-term hazard management plan

The California Coastal Commission Coastal Development Permit G-6-17-0002 requires development of long-term alternatives which address coastal hazards such as sea level rise, El Niño storm events, and shoreline erosion. This report identifies and assesses these coastal hazards for the project site for a range of alternatives.

2. Site Description

San Onofre State Beach (Figure 2.1) is comprised of multiple recreational and natural areas with day-use and overnight camping facilities. Almost all of the 2,000-acre State Beach is located in San Diego County and is leased to the State of California by the Department of the Navy, United States Marine Corps (USMC). The State Beach shoreline is generally divided into three areas (listed from north to south): Trestles Beach, Surf Beach, and Trails Beach. These areas span from San Mateo Point to the north and San Onofre Bluffs to the south.

Figure 2.1: San Onofre State Beach Map *(CA State Parks 2010)*

This study focuses on Surf Beach, shown in Figure 2.2, an approximately 0.8-mile-long day-use beach area bordered by the Marine Corps Beach Club ("Military Beach") to the north, the San Onofre Nuclear Generating Station (SONGS) to the south, and the railway and San Diego Freeway I-5 on the inland side.

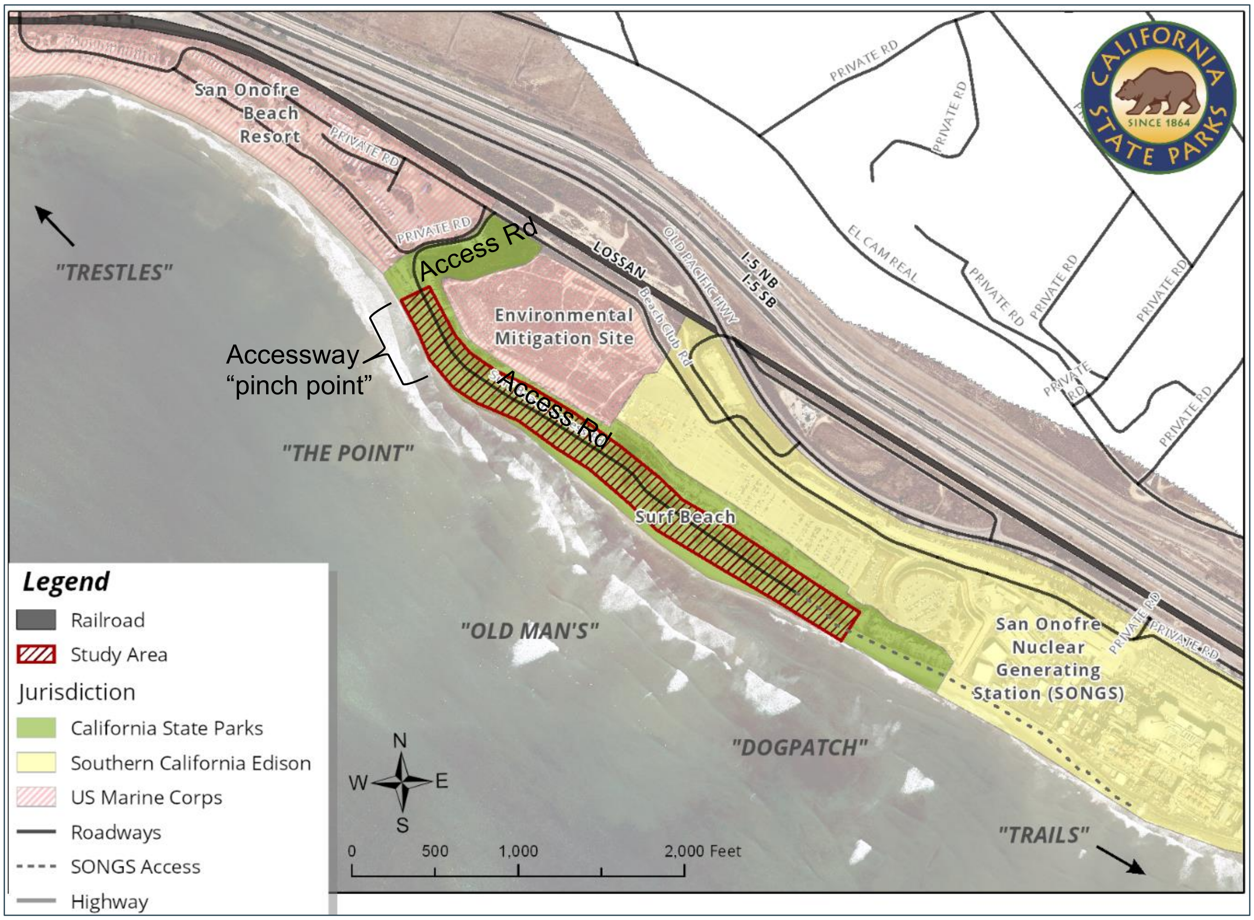

FIGURE 2.2: SURF BEACH STUDY AREA SITE MAP

The State Beach is accessed via a road from the bluff-top, (Figure 2.3), where visitors can drive to the beachfront and then continue along an earthen road at the back of the beach (Figure 2.4). Beach users can park along the approximately 2,800-ft-long earthen road where permitted within the limits of the seaward log barriers. Spaces are not marked, but State Parks estimates that there are up to 320 parking spaces available. Wider beach widths in the past allowed for a longer beachfront access road and approximately 40 additional parking spots to the south. The beach road and parking area is closed during wet weather and high surf conditions. A 28-stall paved parking lot is also available approximately 500 ft inland from the beachfront, along the lateral access road. No vehicles over 25 ft long are permitted at Surf Beach.

A significant access issue presently exists at a "pinch point" at the north/west end of the park where the beach and road are narrow. The pinch point separates the majority of the parking lot from the access road. Of the 320 parking spaces, approximately 300 are south of this pinch point, i.e. a significant amount of the parking spaces is not available if access is precluded to the south of the pinch point.

Beach facilities include chemical toilets, cold showers, and a few picnic benches and fire pits. There is a palapa-style shade structure, volleyball courts, and other ornamental landscaping along the south shoreline, maintained by the surf clubs that utilize this area.

FIGURE 2.3: SURF BEACH ACCESS ROAD FROM BLUFF-TOP

FIGURE 2.4: SURF BEACH ACCESS ROAD AND PARKING

The Surf Beach shoreline is comprised of a narrow sandy beach with cobble (Figure 2.5), backed by coastal bluffs (Figure 2.6). The combined width of the sandy beach and road/parking area (bluff toe to wetted edge of sand) currently varies from very narrow (~80ft) near the northern edge at "The Point" surf break to wider (~160ft) at "Old Man's" and "Dogpatch" to the south, (as estimated from a February 2018 aerial image). The nearshore area is relatively shallow with a large amount of cobble and scattered kelp beds (Figure 2.7).

FIGURE 2.5: NARROW SANDY BEACH

FIGURE 2.6: BLUFF-BACKED ROAD

The existing onshore and nearshore biological resources are described in Appendix A.

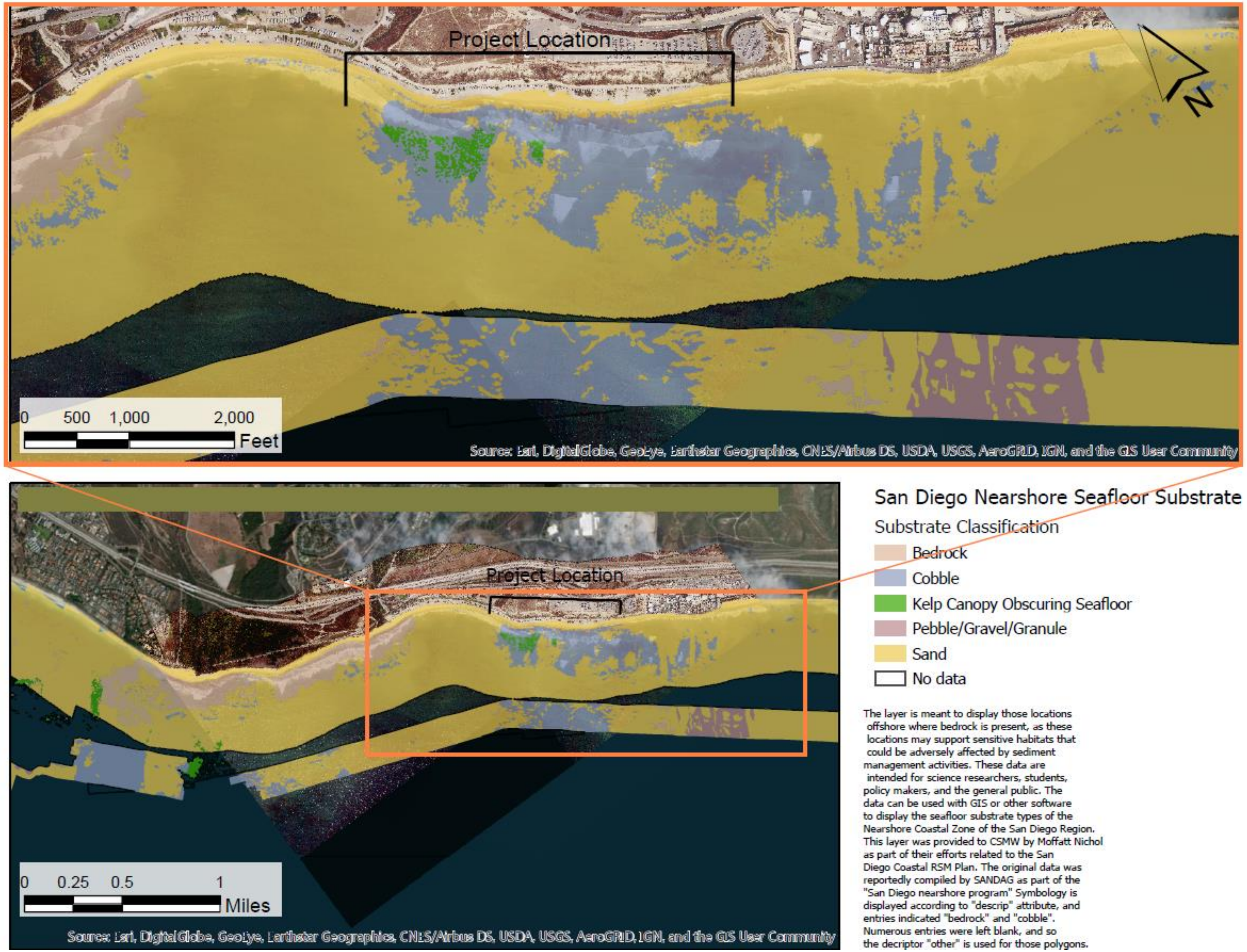

FIGURE 2.7: NEARSHORE SEAFLOOR SUBSTRATE MAP *(COASTAL SEDIMENT MANAGEMENT WORKGROUP – STATE OF CALIFORNIA)*

2.1. Historical Context

In the 1930s, what was a small fishing camp became a popular site for surfing. The Waikiki-like waves drew surfers from around the region and the area was known as the mainland's first "surfing camp." In 1928, private land owners sold the site to the USMC. During WWII, the site was used for military training and relatively few people surfed there. Use of the beach for surfing and recreation began again (illegally) after the war until the San Onofre Surf Club took over as an unofficial caretaker in 1952. The club still exists today and is very present in the local surf community. The State Beach was officially created in 1971 with the leasing of the land from the USMC (Connelly, 2016).

San Onofre State Beach is one of the most popular parks in California with around 2.5 to 3 million visitors annually and is well known for its quality and year-round surf breaks (Connelly, 2016). Just north of the Surf Beach study area is the popular Camp Pendleton Beach Resort and the Trestles portion of San Onofre State Beach. Trestles is also known for its popular surf breaks and has been the site of environmental activism for a number of proposed infrastructure and development projects in the area. The surf break at Trestles is considered the best year-round surf break in America (San Onofre Parks Foundation, 2018).

2.2. Lease Arrangement

The entirety of San Onofre State Beach is within the USMC Base, Camp Pendleton. As stated above, in 1971, the U.S. Department of Defense signed a 50-year lease with the State of California's Department of Parks and Recreation to create San Onofre State Beach. The USMC maintains an environmental mitigation site within the boundary of the State Beach, atop the bluffs backing Surf Beach. The 50-year lease is set to expire in August of 2021. In 2016, the California Department of Parks and Recreation indicated their formal interest to extend the lease and are in the process of re-negotiation with the USMC.

2.3. Relationship with San Onofre Nuclear Generating Station (SONGS)

SONGS is also on land leased from the USMC and the lease is set to expire in 2024.

In June of 2013, Southern California Edison (SCE) formally notified the Nuclear Regulatory Commission that it had permanently ceased operation of Units 2 and 3, which had comprised all commercial power generation operations at SONGS. This began the process of decommissioning the plant. Decommissioning is a well-defined process and includes transferring used nuclear fuel into safe storage and followed by removal and disposal of radioactive material. Ultimately, the process will include limiting residual radioactivity to levels that allow for termination of Nuclear Regulatory Commission contract. This process is being led by *SONGS Decommissioning Solutions*. The decommissioning and restoration process is expected to continue at least through 2035 and have an estimated cost of $4.4 billion (SCE, 2016). Decommissioning workers access some areas of SONGS through the Surf Beach beachfront access road and parking area. Thus, State Parks holds an important stakeholder position in the SONGS decommissioning process.

There is a large paved parking lot on top of the bluff that backs Surf Beach. This parking lot is currently being used in the SONGS decommissioning process; however, it is possible that this lot, or a portion of it could be available for use by State Parks in the future. Potential uses of the SONGS parking lot, as part of a potential alternative, are discussed in a later section of this report.

3. Emergency Rock Revetment

During the 2015-2016 El Niño storm season, the southern portion of the Surf Beach study area experienced significant beach erosion that extended landward to the roadway and parking area. This erosion continued in 2017, leaving portions of the parking areas and roadway unstable with a 10 ft vertical drop from the parking areas' eroded edge to the beach (Figure 3.1 – Figure 3.4). Installation of an emergency revetment was necessary.

Figure 3.1: 2017 Storm Damage, Looking North

FIGURE 3.2: 2017 STORM DAMAGE, LOOKING SOUTH

FIGURE 3.3: NARROW ACCESS WAY RESULTING FROM 2017 STORM DAMAGE *(OC REGISTER, 2017)*

FIGURE 3.4: UNDERMINING OF ROAD/PARKING AREA FROM 2017 STORM DAMAGE *(OC REGISTER, 2017)*

In response to the erosion, State Parks placed approximately 800 linear feet (LF) of emergency rock revetment along the escarpment at the base of the parking and access road on the northern shoreline of Surf Beach. The revetment was constructed in April 2017, in accordance with the requirements of California Coastal Commission Emergency Permit G-6-17-0002 and served to prevent further damage of the parking area and access road.

According to permit drawings and as observed in the field, the emergency revetment is comprised of 3 to 6 ton armor stone underlain by facing class rock and geotextile fabric. Additionally, 8-ton toe stone was placed at the base of the revetment to prevent undermining of the rock slope. The total amount of rock placed was approximately 4,600 tons of armor rock and 2,400 tons of underlayer rock. The crest elevation is approximately +16 to +18 feet (ft) NAVD88, sloping down at a 1.5 horizontal : 1 vertical (1.5:1 H:V) profile to a toe elevation of approximately 0 ft NAVD88.

An aerial view of the emergency revetment in February 2018 is shown in Figure 3.5; approximately 15 ft of the revetment's width is exposed along its entire length. Photographs of the revetment are shown in Figure 3.6, Figure 3.7, and Figure 3.8. The emergency permit and as-built drawings are provided in Appendices B and C, respectively.

FIGURE 3.5: EMERGENCY ROCK REVETMENT, FEBRUARY 2018 PHOTOGRAPH

FIGURE 3.6: CONSTRUCTION OF EMERGENCY ROCK REVETMENT, APRIL 2017 *(SURFRIDER, 2017)*

FIGURE 3.7: EMERGENCY ROCK REVETMENT IMMEDIATELY FOLLOWING CONSTRUCTION, MAY 2017 *(CCC)*

FIGURE 3.8: EMERGENCY REVETMENT APPROXIMATELY ONE YEAR LATER, MARCH 2018

4. Shoreline Characteristics and Coastal Hazards

Surf Beach is a southwest-facing bluff-backed beach with narrow to moderate beach widths over time. This dynamic shoreline has varied in response to natural and anthropogenic effects such as coastal storms, fluvial and longshore sediment inputs, construction of SONGS, and regional-scale changes within the littoral cell such as land development, mining and flood control works along upcoast streams/creeks, and periodic upcoast and downcoast[1] beach nourishments. A discussion of historical shoreline changes, storm events, and causes of erosion are provided in this section.

4.1. Historical Shoreline Conditions

Historical shoreline conditions at Surf Beach were determined from shoreline delineations, reports, and aerial imagery (Figure 4.1 to Figure 4.4). A full catalogue of available historical aerial imagery is provided in Appendix D.

Historical southern California shoreline position delineations from 1889 to 1998 are available for Surf Beach, from the U.S. Geological Survey (USGS). This data is overlaid on a 2010 aerial image in Figure 4.5 and shows the dynamic nature of this shoreline over time. The historical shoreline delineations suggest a narrower shoreline in the early 20th century with wider beach widths in 1972 (coincident with SONGS construction) and in 1998 (coincident with the 1997-1998 El Niño). The “Point” shoreline bulge is present in all historical shorelines, likely created and maintained by the large adjacent cobble field, as shown in the previous Figure 2.7 substrate map.

The construction of SONGS from 1964 to 1985 played the largest role in the historical changes at Surf Beach. Construction excavation produced a large volume of sand (approximately 1.3 million cubic yards), which was placed on the shoreline fronting the power station creating a seaward bulge; some material was also placed on adjacent beaches. These activities not only increased beach widths from the direct placement of sand but also interrupted the longshore flow of sand, further widening beaches, including Surf Beach, upcoast of the bulge. Following construction, these features quickly dispersed and retreated, along with the former gains at adjacent beaches. Aerial imagery depicting these shoreline changes is shown in Figure 4.6.

A series of natural “barrancas” (eroded canyons / gullies) were previously present along the Surf Beach bluffs, as can be seen in the 1932, 1938, 1953, and 1960 aerial imagery on the previous pages. These barrancas were filled with excavated terrace deposits during the initial years of SONGS construction; available aerial imagery indicates the fill occurred sometime between 1960 and 1965. Figure 4.7 shows the bluff in its filled state, which persists today.

[1] The terms “upcoast” and “downcoast” used throughout this report are generally intended to refer to the north and south of Surf Beach, respectively.

FIGURE 4.1: **AERIAL PHOTO FEBRUARY 1932 *(UCSB LIBRARY)***

FIGURE 4.2: **AERIAL PHOTO MAY 1938 *(UCSB LIBRARY)***

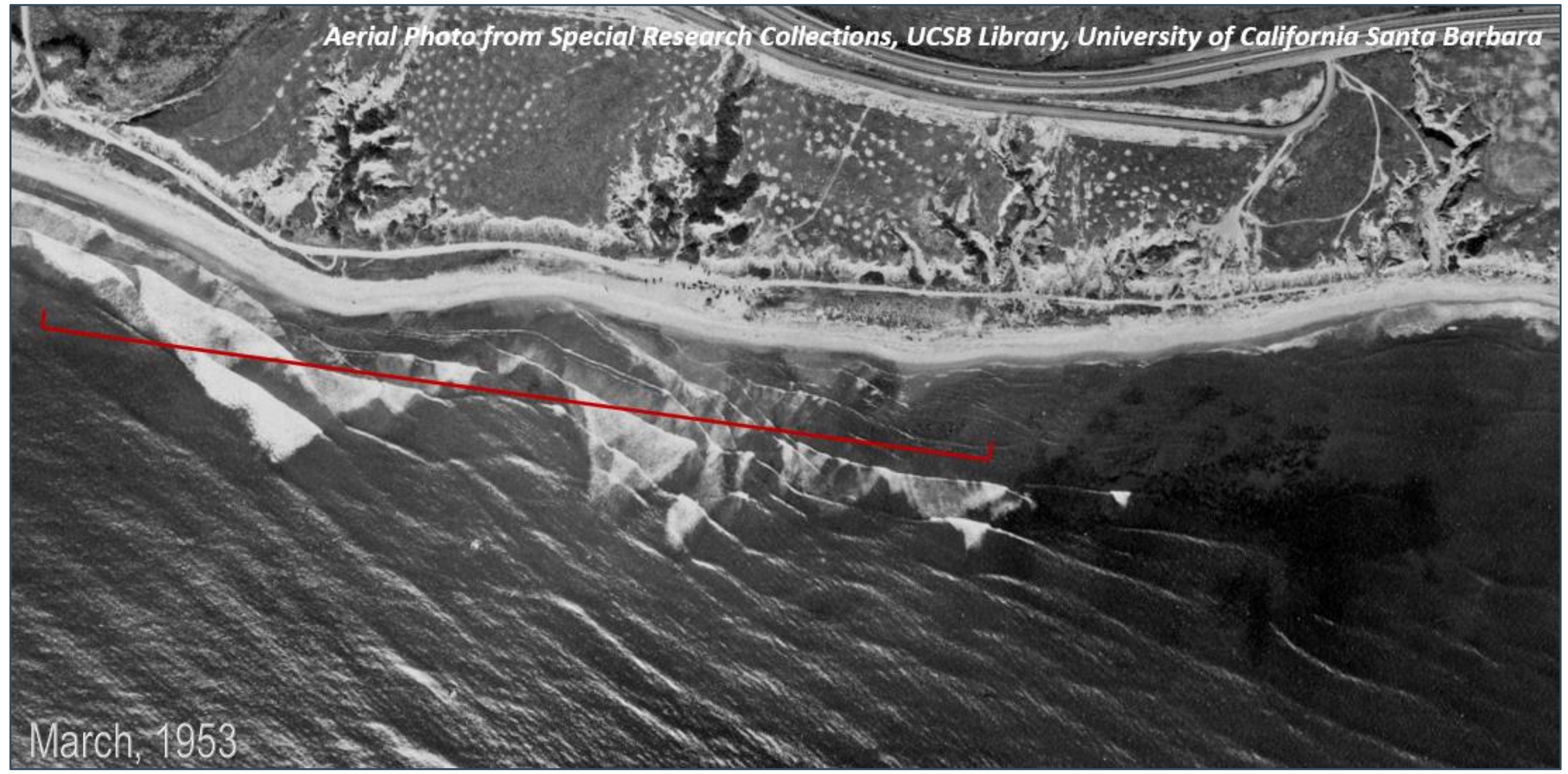

FIGURE 4.3: AERIAL PHOTO MARCH 1953 *(UCSB LIBRARY)*

FIGURE 4.4: AERIAL PHOTO MAY 1960 *(UCSB LIBRARY)*

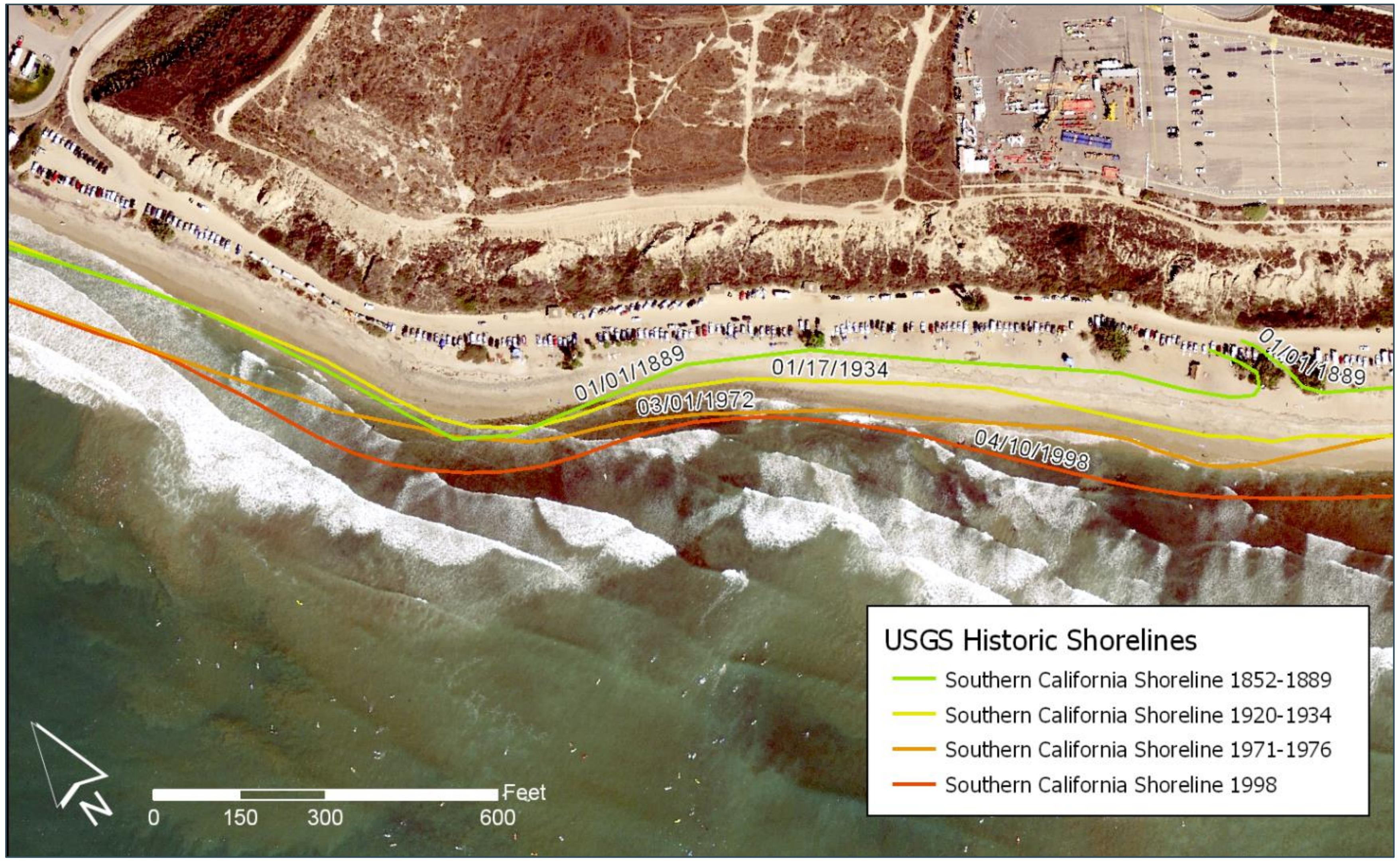

FIGURE 4.5: USGS HISTORICAL SHORELINE DELINEATION (WITH 2010 BACKGROUND AERIAL IMAGE)

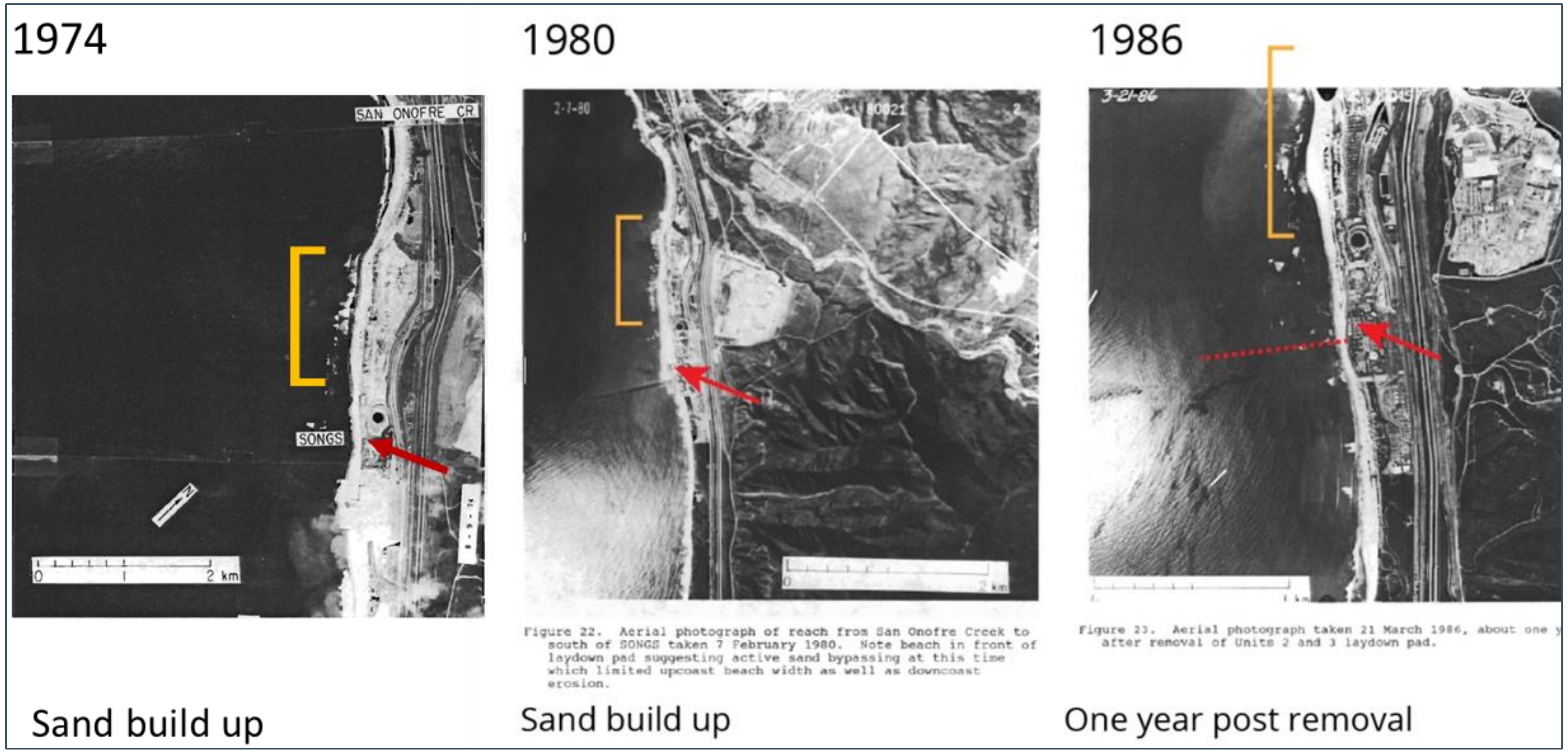

Figure 4.6: Shoreline Changes During SONGS construction *(Flick 1989)*

Figure 4.7: Aerial Photo, February 1965 *(UCSB Library)*

Historical data is also available from the 1991 U.S. Army Corps of Engineers (USACE) *Coast of California Storm and Tidal Wave Study.* The study includes survey information for shore-perpendicular transects along the San Onofre coast. The transect locations are shown in Figure 4.8. Transect SO 1530 is located near the northern end of Surf Beach and Transect SO 1470 is located farther downcoast, south of SONGS. The shoreline position graph for the downcoast Transect SO 1470, (Figure 4.9), indicates a moderate loss of beach width in the mid-1970s and a relatively significant increase in 1980. The USACE (1991) report does not include Surf Beach data after 1980.

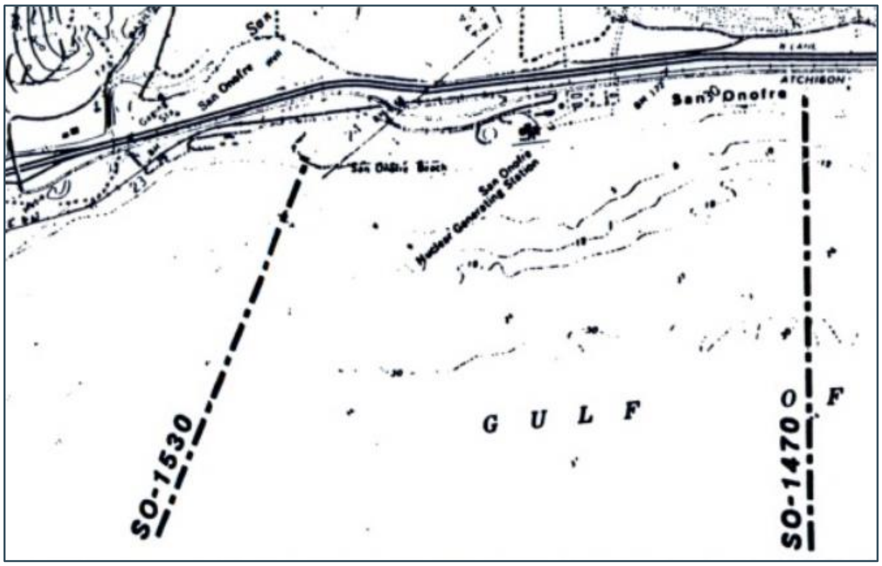

FIGURE 4.8: USACE TRANSECT LOCATIONS *(USACE 1991)*

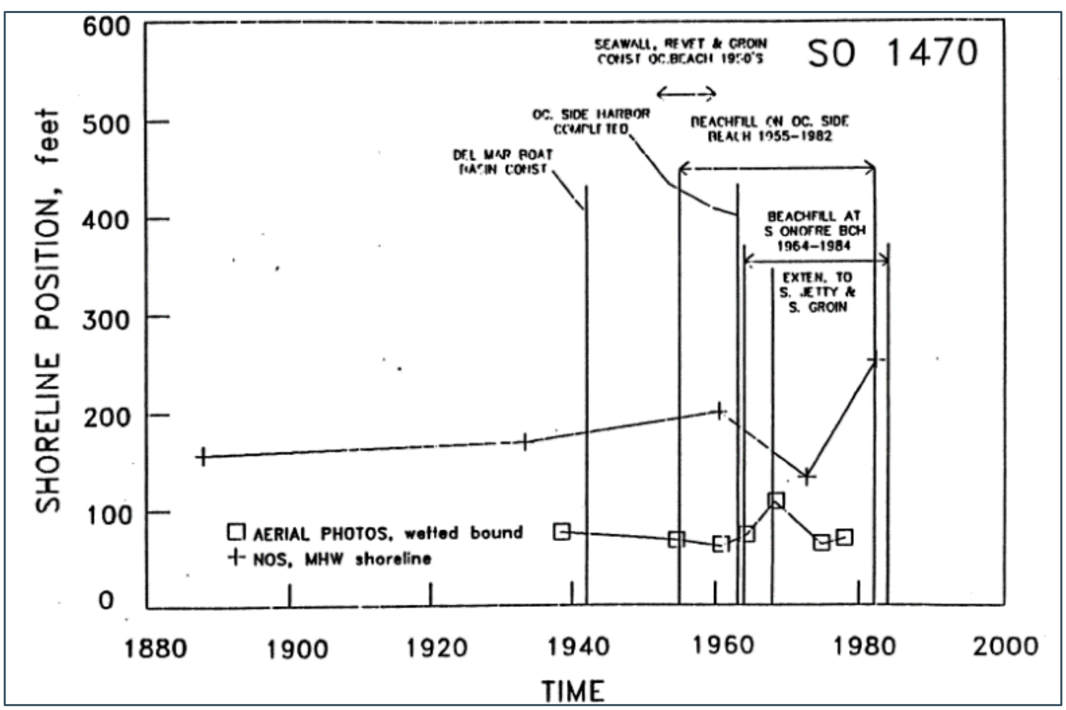

FIGURE 4.9: HISTORIC SHORELINE POSITION SOUTH OF SONGS *(USACE 1991)*

4.2. Recent Shoreline Conditions

Aerial photographs (Figure 4.10 - Figure 4.15) show fluctuations in the Surf Beach shoreline from 1994 to 2018, based on both timeframe and season. The photos indicate that beach widths over the past 24 years exhibit similar variability to beach widths over the period from 1932 to 1960. Moderate beach widths in 1932, 1953, and 1960 are similar to those in May 1994, March 2003, and February 2016, while the narrow beach width in 1938 is similar to those in November 2003 and October 2016. The most recent aerial image from February 2018 shows the beach has partially recovered from its eroded condition of October 2016.

4.3. Causes of Erosion

4.3.1. Littoral Sediment Transport and Sediment Supply

A littoral cell is a segment of shoreline in which littoral (coastal) sediment transport is bounded or contained. San Onofre State Beach is part of the Oceanside Littoral Cell, which spans from Dana Point Harbor to La Jolla, a distance of approximately 50 miles. The shoreline in this cell generally consists of narrow beaches that are backed by seacliffs, bluffs, and mouths of coastal streams and rivers.

The Oceanside Littoral Cell is considered to have two sub-littoral cells: North (Dana Point to Oceanside Harbor) and South (Oceanside to La Jolla). The northern portion of the littoral cell, which includes San Onofre State Beach, receives the majority of its sediment from San Juan Creek in Dana Point (USACE, 2012). The sediment contribution to the beaches from San Juan Creek has been estimated to be between 34,000 and 56,000 cubic yards (cy), on average, per year over recent time (Ninyo & Moore, 2015). This compares to previous historical annual yields from San Juan Creek of up to 93,000 cy (Flick, 1993). The net downcoast, wave-induced longshore transport rate was previously estimated to be 260,000 cy per year for the Oceanside Littoral Cell (Flick, 1993).

Additionally, Surf Beach receives sediment from the upcoast San Mateo Creek and a very limited amount from the adjacent San Onofre Creek. Aerial imagery shows that sand bars and variable beach widths have existed at the mouth of San Mateo Creek following river flow discharge events. San Mateo Creek is one of the last natural-bottom creeks of Southern California and has historically been a seasonal creek with limited flow during the dry season. A USACE 2012 study showed the sediment discharge from San Mateo Creek to range from approximately 5,000 to 32,000 cy per year. No data is available for the San Onofre Creek sediment yield, but it is assumed to be relatively low based on the size of the creek.

In natural conditions, Surf Beach would also receive sediment inputs from bluff erosion; however, due to upcoast development and armoring of the LOSSAN railroad, bluff sediment inputs in the upcoast Dana Point-San Clemente subcell (which spans from Dana Point Harbor to San Mateo Point) have been reduced from 58,800 cy per year to 0 cy per year (USACE, 2012).

Flick (1993) cites that sand nourishment events historically contributed an annual mean amount of 250,000 cy to the Oceanside Littoral Cell; this amount is approximately equal to the most optimistic estimate of contributions from rivers and creeks over the same time frame (1940s to 1990s) and exceeds the lowest estimate of river contributions by almost a factor of two. These artificial sand inputs helped maintain narrow beaches such as San Onofre State Beach, but have been reduced in recent decades.

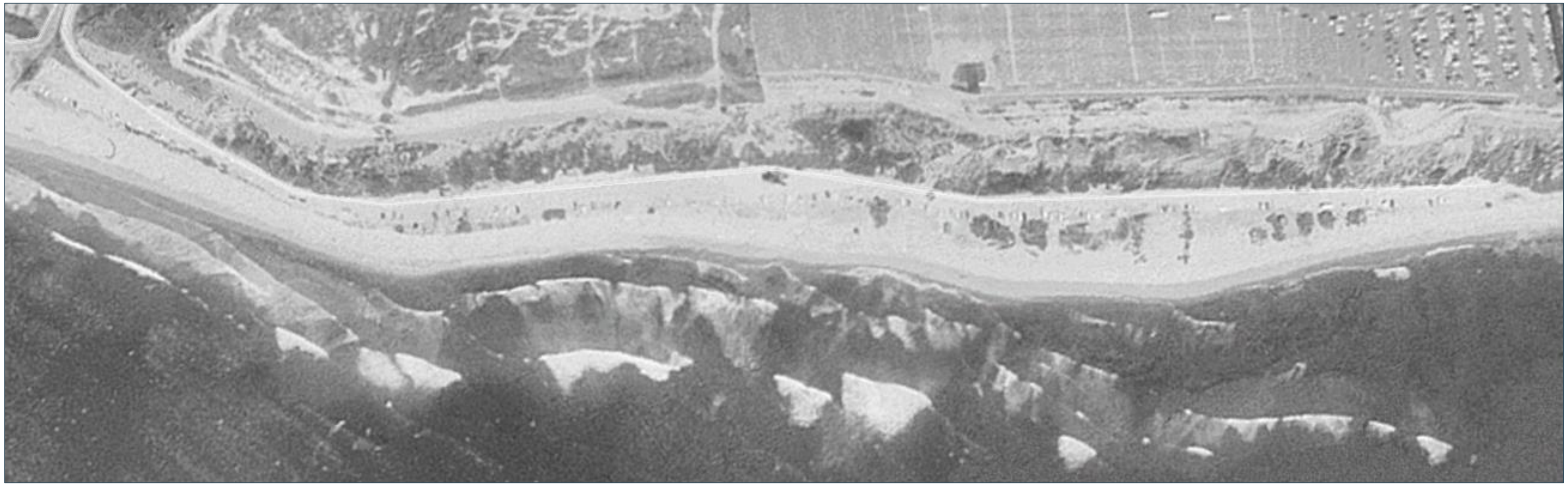

FIGURE 4.10: AERIAL IMAGE MAY 1994 *(GOOGLE)*

FIGURE 4.11: AERIAL IMAGE MARCH 2003 *(GOOGLE)*

FIGURE 4.12: AERIAL IMAGE NOVEMBER 2003 *(GOOGLE)*

FIGURE 4.13: AERIAL IMAGE FEBRUARY 2016 *(GOOGLE)*

FIGURE 4.14: AERIAL IMAGE OCTOBER 2016 *(GOOGLE)*

FIGURE 4.15: AERIAL IMAGE FEBRUARY 2018 *(GOOGLE)*

4.3.2. Past Storm and Erosion Events

San Onofre State Beach and its facilities are particularly susceptible to damage from storm events due to exposure of the shoreline. The shoreline at Surf Beach has experienced erosion events that resulted in temporary closure of the access road and the need for major maintenance of the road. Closure of the Surf Beach road is also common following heavy rain, due to muddy conditions. Particularly notable historic storm and erosion events, resulting in significant damage at Surf Beach and to this region of the coastline, are:

- 1969: The Surf Beach roadway was completely washed out and was repaired by one of the surfing clubs (San Clemente Times 2017).
- Winter Storms of 1982-1983: A sequence of eight major storms struck the California coast between November 1982 to mid-March 1983. The waves associated with these storms were exceptional because of their height, long periods, and more westerly approach. Coastal damage was aggravated by the synchronization of the storms with unusually extreme water levels, driven by tides, storm surges, and El Niño effects. The combination of these sea level increases resulted in substantial flooding of low lying areas as well as wave attack on structures that would normally be protected by the limitation of water depth. Significant erosion occurred along the Southern California shoreline and many beaches never recovered from this event.
- Winter storm on January 17-18, 1988: High tides and storm waves during this period caused substantial flooding of low lying areas as well as wave attack on structures that would normally be protected by the limitation of water depth.
- El Niño of 1997-1998: The sequence of storms during this season resulted in intense rains that caused flooding, landslides, debris flow, and coastal cliff erosion. During the winter months (December-February), the Southern California coastline received 24 inches of rain (230% the average precipitation), resulting in more than $500 million in damages and 17 deaths (Ross et al., 1998).
- 2009: Heavy rains and beach erosion required closure of part of the Surf Beach roadway and parking area. (OC Register 2016).
- El Niño of 2015-2016: With a sea level anomaly measuring approximately 1 ft above predicted tides and winter wave energy meeting or exceeding historic measurements, the 2015-2016 El Niño event was one of the strongest in historical record. Shorelines retreated beyond previously measured extremes in many locations as wave energy eroded beaches starved of riverine sediment from a multi-year drought and an unusually dry El Niño, limiting beach recovery (Barnard et al., 2017). 2016 was the beginning of recent erosion problems at Surf Beach. A series of large west swells combined with high tides eroded the beach parking areas at Dogpatch (near the eastern project area) (OC Register 2016).
- 2017: Persistent wave energy and high tides caused a stretch of the Surf Beach road to collapse, resulting in temporary closure of the road in January 2017 (San Clemente Times 2017) and resulting in the need for the emergency revetment discussed previously.

The State of California also experienced a multi-year drought spanning from December 2011 to March 2017, which was the driest period of historical record. During this extended dry period, erosion occurred as would be expected at San Onofre State Beach, as creeks were dry and not delivering sediment to the coastline. Without sediment delivery from San Juan or San Mateo Creeks and with no other substantial sediment sources, beach erosion occured as sediment was transported offshore by waves and downcoast due to littoral drift.

In the midst of the drought, the sediment-starved Surf Beach was also subject to the erosive wave energy of the 2015-2016 El Niño, which further exacerbated beach erosion. With the wave action and high water levels of the 2016-2017 winter, the narrow beach provided little protection to the State Parks access road and parking area. This combination of California's historic drought and the El Niño high water and storm events likely resulted in the acute erosion which resulted in the loss of beach parking areas and portions of the roadway.

4.3.3. Projected Future Shoreline Erosion

Shoreline erosion is likely to continue to be an issue along San Onofre State Beach as a result of the following:

- Increased magnitude and frequency of El Niño /Southern Oscillation (ENSO) events, (Cai et al., 2014);
- Decreased nourishment activities at upcoast beaches;
- Future sea level rise;
- Migration of the beach landward due to sea level rise (Bruun rule);
- Increased breaking wave heights along the shoreline due to higher water levels; and
- Extended periods of drought, which result in decreased sediment supply from upcoast rivers and creeks.

Projected shoreline erosion along Surf Beach, based on various future sea level rise scenarios, is discussed further in a following section.

5. Oceanographic Conditions

Oceanographic conditions play a significant role in determining coastal hazards such as flooding and erosion. Oceanographic conditions drive coastal processes which influence the behavior of sediment transport and, consequently, the shoreline position at San Onofre State Beach. The following sections provide a general understanding of the wave and water level conditions in order to attempt to predict future shoreline changes.

5.1. Tides / Water Levels

The tides in Southern California are semidiurnal (~12.42-hour frequency), meaning there are two low and two high waters each tidal day (~25-hour period). The tidal range varies from tide to tide, thus the tides are also considered to have a diurnal inequality. In Southern California, the highest tides of the year usually occur in the winter months, which is also the season that exhibits the most storms typically causing beach erosion.

The nearest, long-term sea level record is the La Jolla tide gage (Station 9410230) operated by the National Oceanic and Atmospheric Administration (NOAA). The gage is located on the Scripps Pier, which has been collecting data since 1924. The gage data are summarized in Table 5.1.

Table 5.1: Water Levels in La Jolla (1983-2001 Tidal Epoch) *(NOAA, 2017)*

Description	Elevation (ft, MLLW)	Elevation (ft, NAVD88)
Extreme High Water (11/25/2015)	7.79	7.61
Mean Higher High Water (MHHW)	5.33	5.15
Mean High Water (MHW)	4.60	4.42
Mean Sea Level (MSL)	2.73	2.55
National Geodetic Vertical Datum 1929 (NGVD 29)	2.29	2.11
Mean Low Water (MLW)	0.90	0.72
North America Vertical Datum 1988 (NAVD88)	0.18	0.00
Mean Lower Low Water (MLLW)	0.00	-0.18
Extreme Low Water (12/17/33)	-2.87	-3.05

Extreme ocean water levels for a range of return periods can be estimated by statistical analysis of the measured water level data. NOAA conducted a statistical analysis for the data collected at Scripps Pier from 1924 through 2006; results are presented in Table 5.2. As shown in the table, the 100-year extreme ocean water level estimated is +7.43 ft, NAVD88, which is close to the highest observed tidal elevation of +7.61 ft, NAVD88.

TABLE 5.2: STATISTICAL EXTREME HIGH WATER LEVELS BASED ON HISTORICAL RECORD *(NOAA, 2017)*

Event	Elevation (ft, NAVD88)
100-Year	7.43
75-Year	7.40
50-Year	7.38
10-Year	7.21
1-Year	6.52

5.2. WAVES

Waves act to transport sand in both the cross-shore direction (perpendicular to shore, onshore-offshore transport) and alongshore direction (parallel to shore, downdrift transport). Waves can also cause short-duration flooding events by creating dynamic increases in water levels. Thus, the wave climate (or long-term exposure of a coastline to incoming waves) and extreme wave events are important in understanding future vulnerabilities to Surf Beach and its facilities.

In Southern California, wave energy is typically greater in the winter, resulting in shoreline erosion as material is moved offshore, forming sandbars, and downdrift. In the summer, gentler waves facilitate landward movement of offshore/nearshore material, resulting in shoreline accretion (wider beaches). In some cases, the amount of sand eroded by winter wave energy exceeds the natural rate of summer beach recovery resulting in longer-term shoreline retreat. Figure 5.1 shows typical seasonal variability in beach profiles. These conditions result in seasonal variation at San Onofre State Beach which can be seen in historical imagery (Appendix D).

Comparison of Surf Beach aerial imagery between summer/fall months and winter/spring months shows fluctuations in beach widths and offshore sand deposition that is consistent with typical Southern California seasonal fluctuation trends. Limited beach profile data (Figure 5.2) and anecdotal information also support that there is a typical seasonal variation along Surf Beach.

Wave energy can result in flooding as water from breaking waves travels up a beach or coastal structure and splashes or flows over the shoreline crest to inland areas. The maximum elevation that water from a breaking wave could reach on an infinite slope is known as the wave runup elevation. Overtopping occurs when the wave runup elevation exceeds the shoreline or structure crest elevation. Past overtopping events at San Onofre State Beach have resulted in flooding and deposition of sand and cobble in the parking area, resulting in the need for periodic road and parking area repair. Wave runup and overtopping is further characterized for each of the shoreline management alternatives in a following section.

Significant wave events are most damaging when they coincide with high water levels which can be driven by tides, storm surge, and El Niño effects. The combination of high sea levels and large waves allows wave attack on structures that would normally be protected by the limitation of water depth. A significant wave event that occurs during a low tide may not result in notable flooding or erosion, while a comparatively smaller wave event coinciding with high sea levels can result in substantial flooding and erosion. During the 2015-2016 El Niño, high water levels coincided with moderate wave heights and resulted in damages, flooding, and erosion along the coastline.

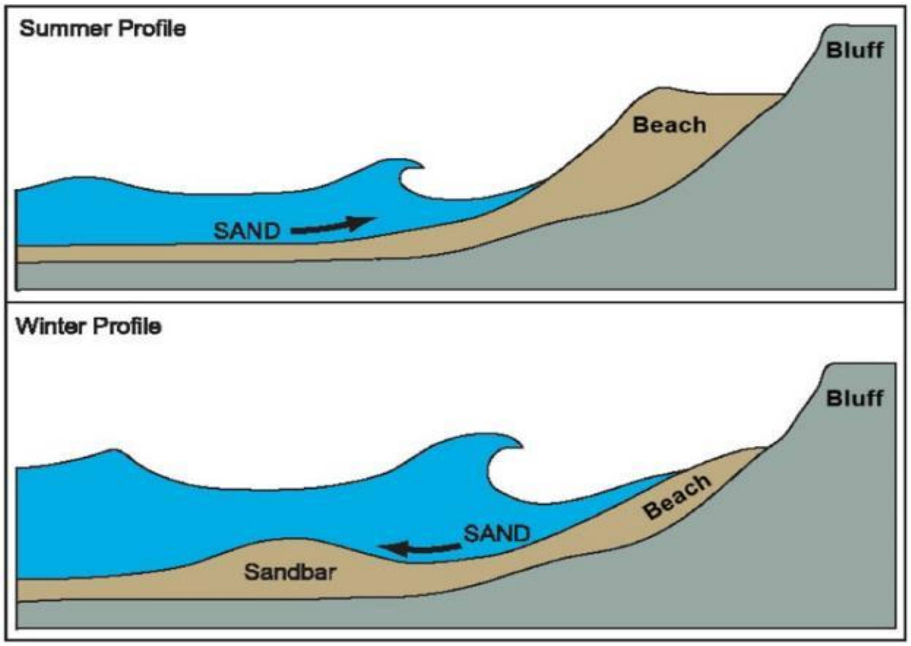

FIGURE 5.1: SCHEMATIC OF SAND MOVEMENT DUE TO VARYING WAVE HEIGHTS *(PATSCH AND GRIGGS, 2007)*

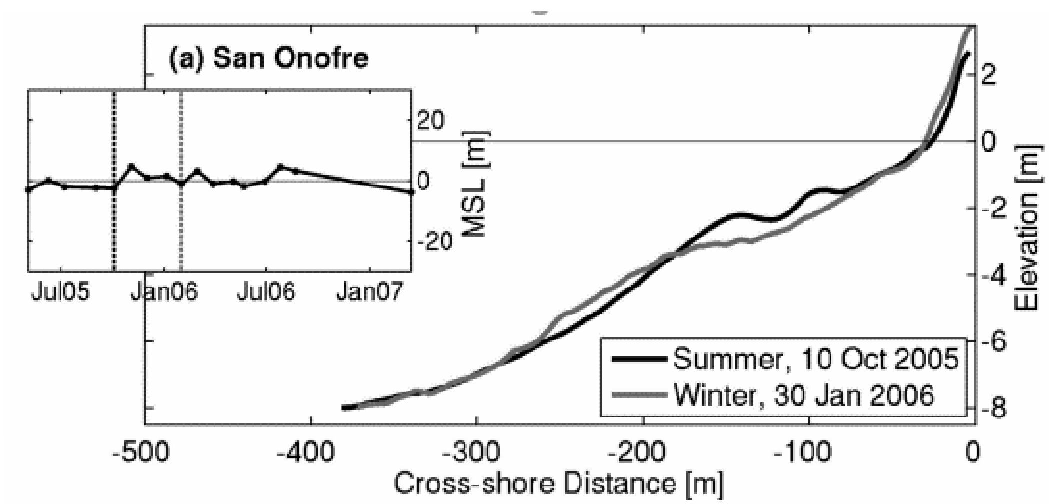

FIGURE 5.2: SEASONAL BEACH PROFILES COMPARISON *(YATES, 2009)*

5.2.1. Extreme Wave Conditions

The most recent study of wave hazards at San Onofre State Beach is the 2016 FEMA Open Pacific Coast Study of the California Coastal Analysis and Mapping Project (CCAMP). The results of this study were used to create Preliminary Flood Insurance Rate Maps (PFIRMs) which are intended to supersede the current FIRMs. These maps include updated coastal flooding hazards that are based on current conditions and do not consider future sea level rise or erosion. The PFIRM is expected to be adopted as the official FIRM over the next year.

The PFIRMs depict the extents and elevation of the 100-year (1% annual chance) total water level (TWL), known as the base flood elevation (BFE). For areas prone to coastal flooding, like Surf Beach, the TWL represents the still water level (water surface elevation resulting from astronomical tides, storm surge, and freshwater inputs) combined with the heights of wave setup and wave runup. Parameters including ocean wave, wind, and water level data are based on a hindcast (analysis of past events) for the period of January 1, 1960 to December 31, 2009 at various points along the California coastline. A statistical analysis was performed on wave runup calculations for 50 of the largest wave events in this period to yield the 100-Year BFE.

The preliminary 100-Year BFEs (mapped runup elevations) at Surf Beach are +20 ft north of The Point (transect 2) and +22 ft NAVD88 south of The Point (transect 3), with flooding extending inland to the toe of the bluff as shown in Figure 5.3. This 100-Year event would likely result in bluff erosion, significant damages to the parking and access road which have typical elevations of +15 ft to +18 ft NAVD88, and damage to other infrastructure along the coastline (as has occurred previously). An unpaved access road and surface parking area are generally not designed to withstand a 100-Year event because they are not critical facilities and would carry a relatively high cost to design for a 100-Year event compared to the costs to repair damages.

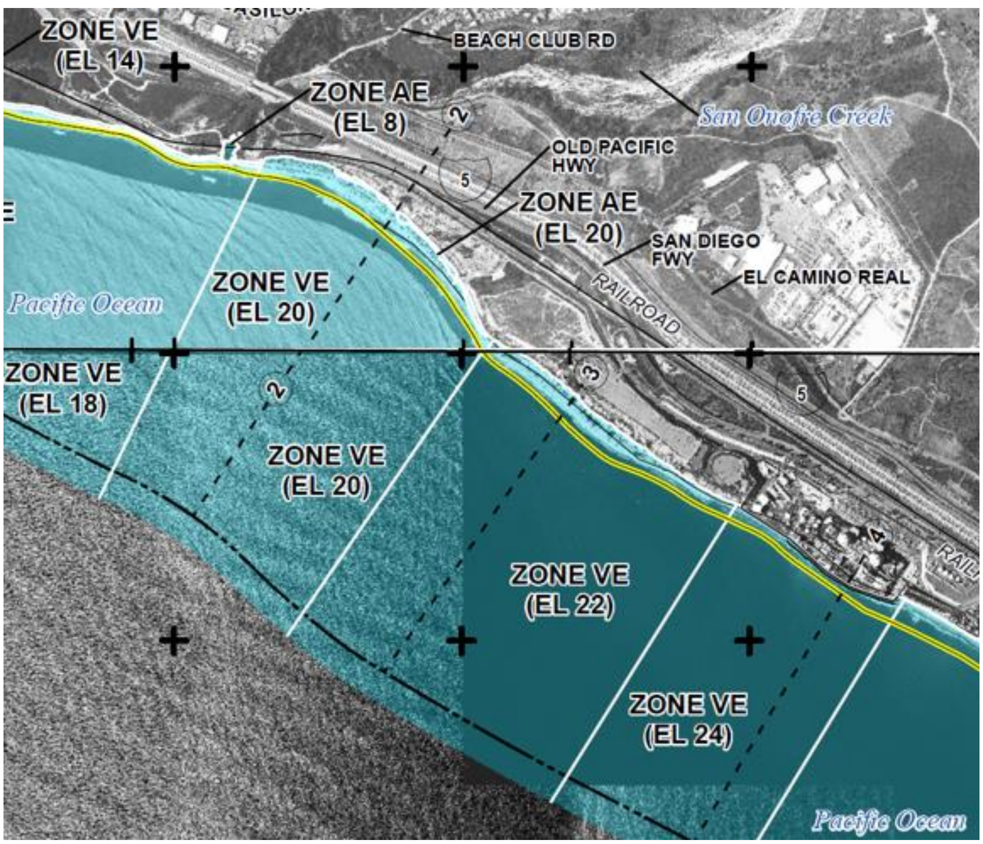

FIGURE 5.3: FEMA PFIRM EXCERPT, PANELS 100 (TOP) AND 425 (BOTTOM) ***(FEMA 2017)***

The FEMA study also calculated TWLs for 500-Year (0.2% annual chance), 50-Year (2% annual chance), 25-Year (4% annual chance), and 10-Year (10% annual chance) return period wave events. These values are summarized in Table 5.3. FEMA wave runup calculations show that even during a 10-Year event, the existing Surf Beach road and parking area would be subject to flooding and resulting erosion. Higher TWLs correlate with increased flooding, erosion, and infrastructure damage.

TABLE 5.3: FEMA WAVE RUNUP ELEVATIONS *(FEMA 2017)*

Wave Event Return Period	Total Water Level (ft, NAVD88)	
	Transect 2	Transect 3
500-Year (0.2% Annual Chance)	21.2	22.4
100-Year (1% Annual Chance)	20.3	21.5
50-Year (2% Annual Chance)	19.9	21.0
25-Year (4% Annual Chance)	19.4	20.6
10-Year (10% Annual Chance)	18.7	19.9

5.2.2. El Niño Southern Oscillation

El Niño conditions are characterized by unusually warm ocean temperatures in the Equatorial Pacific. El Niño is an oscillation of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe. Storms increase in frequency and intensity, elevating monthly mean significant wave heights and water levels (NOAA 2015). During the 2015-2016 El Niño season, Southern California ocean water levels were up to 1 ft higher than predicted and measured wave energy matched or exceeded previous records.

El Niño conditions also have the potential to increase the frequency and intensity of storms, thus increasing winter significant wave heights. Resulting conditions and damages from a large wave event that can be expected at Surf Beach during El Niño could be similar to other previous wave, such as the winter storms in 2015-2016 which eroded the beach, roadway, and parking area. If peak wave heights observed throughout the duration of that El Niño event had coincided with high tide levels, damage would have been even greater.

5.3. SEA-LEVEL RISE SCIENCE AND PROJECTIONS

Sea levels are projected to rise in coming decades as a result of increased global temperatures associated with climate change (IPCC, 2013). Shoreline management and adaptation methods along Surf Beach must address these sea level rise projections.

5.3.1. SLR Projections and Guidance

Numerous planning and policy-level guidance on sea level rise (SLR) have been released by international, federal, and state entities. These guidance documents are generally based on research and publications developed by the scientific community. The most applicable guidance to this study are the:

- State of California Ocean Protection Council (OPC) *Sea Level Rise Guidance Document* (OPC-SAT 2018);
- California Coastal Commission *SLR Policy Guidance* (CCC 2015);
- California Department of Parks and Recreation *Sea Level Rise and Extreme Event Guidance* (Parks, 2017); and
- California Natural Resources Agency (CNRA) *Safeguarding California Plan: 2018 Update, California's Climate Adaptation Strategy* (CNRA 2018).

The 2018 OPC SLR Guidance Document is based on an original report which looked at the best available science for California called *Rising Seas in California: An Update on Sea Level Rise Science* (OPC-SAT 2017). The OPC 2017 report was prepared and peer-reviewed by the nation's foremost experts in coastal processes and climate science and provides the foundation for the OPC 2018 guidance. The 2017 OPC report included advanced sea level rise modeling and improved understanding of processes that could drive extreme global sea level rise from land-ice loss at the poles.

The 2018 OPC report uses a probabilistic approach as opposed to previous approaches which use scenario-based projections. These probabilistic projections associate likelihoods of occurrence with sea level rise heights and rates and are directly tied to greenhouse gas emissions scenarios. The applicable "likely range" (66% probability) for this region is detailed in Table 5.4 below. The OPC guidance also recommends consideration of an extreme scenario called H++ which reflects recent findings on potential rates of land-ice loss in Antarctica which could result in much faster rates of sea level rise, basically a "worst-case" scenario. This science is still being updated but is recommended to be considered for high-risk and long-term decisions.

TABLE 5.4. SLR PROJECTIONS AT LA JOLLA TIDE STATION *(OPC-SAT 2018)*

Year	Likely Range (ft) 66% probability sea level rise is between…	1-in-200 chance 0.5% probability sea level rise meets or exceeds…	H++ (Sweet et al. 2017) high emissions scenario
2030	0.4 – 0.6	0.9	1.1
2050	0.7 – 1.2	2.0	2.8
2100	1.8 – 3.6	7.1	10.2

The California Coastal Commission SLR policy guidance was adopted by the Commission in August 2015. It recommends use of the best available science for SLR, which at that time was the 2012 National Research Council's report, *Sea Level Rise for the Coasts of California, Oregon and Washington: Past, Present and Future.* The Commission's document focuses on how to apply the California Coastal Act to the "challenges presented by sea level rise" through Coastal Development Permit decisions and Local Coastal Program updates. It also is part of a statewide strategy for adaption planning to address the impacts of a changing climate.

Since it is likely that any proposed long-term solution at Surf Beach will require regulatory approval from the U.S. Army Corps of Engineers (USACE), it is also important to understand federal policies regarding planning for sea level rise. Federal guidance can be found from the USACE Engineering Circular (EC) No. 1165-2-212 of October 2011 (USACE 2011), which recommends consideration of three SLR scenarios (low, intermediate, and high) for civil works projects.

5.3.2. SLR Model

The latest regional SLR coastal flooding and erosion model available for the San Diego County coast is CoSMoS Version 3.0 Phase 2. CoSMoS (Coastal Storm Modeling System) was developed by the U.S. Geological Survey (USGS) and incorporates global, regional, and local models to assess coastal flooding and erosion. CoSMoS includes 40 combinations of SLR and storm scenarios that apply wave projections, storm surge, sea level anomalies, river discharge, tides, and SLR. The CoSMoS model is listed as an applicable resource for evaluating SLR exposure in the California Department of Parks and Recreation 2017 *Sea Level Rise and Extreme Event Guidance.*

CoSMoS COAST provides coastal erosion results including long-term erosion resulting from SLR and projected wave conditions and was used to select applicable SLR scenarios for Surf Beach. These results are useful for high-level evaluations and are dependent on the accuracy of survey data, the time of survey, and other model assumptions. Selected CoSMoS SLR scenarios applicable to Surf Beach are shown in Figure 5.4 – Figure 5.6.

Bluff erosion is also included in the USGS CoSMoS model. Historical bluff retreat rates are based on the difference in bluff edge position (top of bluff) between 1930's data and a 2010 LIDAR survey.

It should be noted that the historical average rate approach used in the USGS CoSMoS model may not be representative of the stochastic and episodic nature of bluff failure and retreat and may significantly under-predict the retreat for episodic events. The USGS alongshore-averaged rate is 0.21 +/- 0.2 m/yr (0.69 +/- 0.6 ft/yr) along the Marine Corps Base Camp Pendleton shoreline (69 feet over 100 years), (Young, 2013). These estimates vary widely from 21 m (69 ft) to over 150 m (495 ft) and represent the possible range of future bluff retreat assuming little change from historical conditions.

Young (2013) has also developed a bluff retreat model for the San Onofre region coastline. Based on sea level rise ranging from 1.6 ft to 6.6 ft over 100 years, the model calculated mean cliff retreat ranging from 13 to 285 ft and maximum rate ranging from 68 to 587 ft, over the 100-year period over the range of SLR. These model outputs provide order-of-magnitude estimates and do not account for processes uncontrolled by profile sand balance such as deep-seated landsliding known to occur in the area. Future gully erosion will also cause terrace incision not included in the bluff retreat estimates (Young, 2013).

FIGURE 5.4: COSMOS SHORELINE EROSION PREDICTIONS – 0.8 FT (10 IN. / 25 CM) SLR

FIGURE 5.5: CoSMoS SHORELINE EROSION PREDICTIONS – 1.6 FT (20 IN. / 50 CM) SLR

FIGURE 5.6: COSMOS SHORELINE EROSION PREDICTIONS – 3.3 FT (40 IN. / 100 CM) SLR

5.3.3. SLR Scenarios for Evaluating Selected Alternatives

For the purpose of evaluating potential shoreline alternatives, four sea level scenarios were considered: 0, +0.8, +1.6, and +3.3 ft, based on the projected shoreline positions per CoSMoS (Figure 5.4 – Figure 5.6). However, the +3.3 ft SLR scenario was not used for wave runup analyses as CoSMoS modeling indicates the shoreline will have retreated landward well into the bluff face and thus it is not likely that any shoreline protection alternative would be practical at that level of SLR. The time horizons for future sea level rise, based on various emissions cases, are shown in Figure 5.7. The selected scenarios for this study are noted on the figure.

As approximated by the Figure 5.7 graph, OPC indicates the time horizon for 0.8 feet of SLR generally ranges from 2030 to 2040 (not including the H++ scenario). With 0.8-ft of SLR, the CoSMoS model projects that the road at the "pinch point" at the northern end of Surf Beach will lose approximately half of its width and the mean high water (MHW) line will be at the seaward edge of the parking area, or beyond, along most of the remaining Surf Beach shoreline.

As approximated by the Figure 5.7 graph, OPC indicates the time horizon for 1.6 feet of SLR generally ranges from 2050 to 2080 (not including the H++ scenario). With 1.6-ft of SLR, the CoSMoS model projects that the road at the "pinch point" will not exist (i.e. the shoreline will be at the toe of the bluff) and the mean high water (MHW) line will be well into the parking area along most of the Surf Beach shoreline.

As approximated by the Figure 5.7 graph, OPC indicates the time horizon for 3.3 feet of SLR generally ranges from 2070 to 2130 (not including the H++ scenario). Under the 3.3-ft scenario, the CoSMoS model projects a shoreline position well into the bluff face (100 ft+), i.e. the beach parking area and road would not exist.

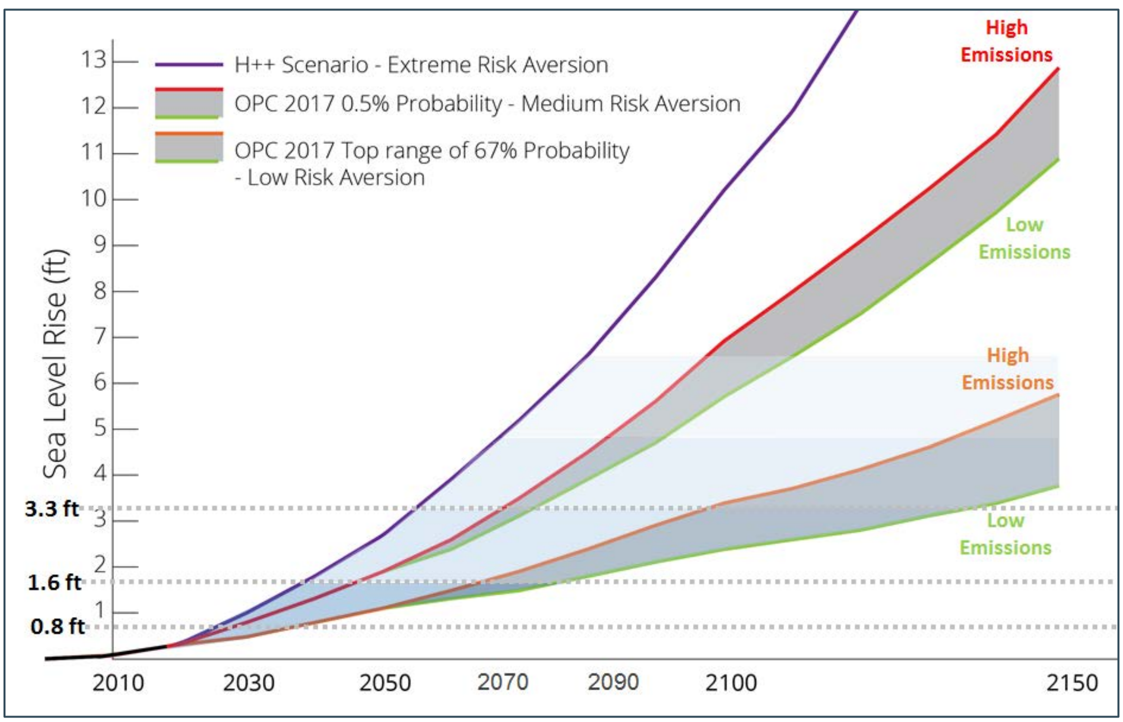

FIGURE 5.7: TIME HORIZONS FOR SEA LEVEL RISE SCENARIOS *(OPC, 2018)*

6. State Policies for Shoreline Management and Adaptation

This section provides an overview of state policies which relate to shoreline management and adaptation methods. Accordingly, any shoreline management and adaptation method to be implemented at Surf Beach should be in compliance with these policies.

6.1. Department Operations Manual (DOM) Coastal Development Siting Policy

The State Parks *Department Operations Manual (DOM) Coastal Development Siting Policy* (0307.3.2.1) strongly suggests that natural coastal processes should not be interrupted. It reads:

> *It is the policy of the Department that natural coastal processes (such as wave erosion, beach deposition, dune formation, lagoon formation, and seacliff retreat) should be allowed to continue without interference. The Department shall not construct permanent new structures and coastal facilities in areas subject to ocean wave erosion, seacliff retreat, and unstable cliffs. New structures and facilities located in areas known to be subject to ocean wave erosion, seacliff retreat, or unstable bluffs shall be expendable or movable.* ***Structural protection and re-protection of existing developments is appropriate only when:***
>
> i. ***The cost of protection over time is commensurate with the value of the development to be protected; and***
>
> ii. ***It can be shown that the protection will not negatively affect the beach or the near-shore environment.***
>
> *Where existing developments must be protected in the short run to achieve park management objectives, including high-density visitor use, the Department should use the most natural-appearing method feasible, while minimizing impacts outside the threatened area.*

6.2. Sea Level Rise and Extreme Event Guidance for California State Parks

The *California State Parks Sea Level Rise and Extreme Event Guidance* document (2017) provides a four-step process for evaluating the potential effects of flooding, inundation, and erosion on State Parks' coastal resources. These four steps are: 1. Define Project ("Project"); 2. Assess Vulnerability to Inundation, Flooding, or Erosion ("Assessment"); 3. Identify Positive and Negative Impacts ("Impacts"); and 4. Make Recommendation ("Recommendation"). These four steps are referenced and addressed throughout this report.

California State Parks convened a Sea Level Rise Working Group in early 2018, whose goal is the development of a statewide State Parks strategy for proactively responding to sea level rise, coastal erosion, and flooding. The strategy is anticipated to include a range of decision support tools to assist park managers in undertaking a range of coastal adaptation actions. When complete, the strategy will support California State Parks' mission in protecting California's valued resources, while providing opportunities for outdoor recreation.

6.3. 2018 Update to the State of California Sea Level Rise (SLR) Guidance

The *2018 Update to the State of California Sea Level Rise (SLR) Guidance* (OPC-SAT 2018) recommends that strategies to protect shoreline development from SLR should minimize shoreline armoring that disrupts natural processes, and that managed retreat should be considered as a strategy that allows for the realignment of development along the coast. Additionally, public access should be preserved while protecting natural resources.

6.4. SAFEGUARDING CALIFORNIA PLAN

The *Safeguarding California Plan* (CNRA 2018) recommends that managed retreat or removal of SLR-threatened developments occurs to allow for the inland retreat of coastal habitats over time (*Safeguarding California* PC.1.6). The document also indicates that management plans should be developed to protect State Parks' infrastructure and vulnerable natural resources from future SLR (*Safeguarding California* PC.1.4).

7. Stakeholder Outreach

Discussions were conducted with three key stakeholder groups in order to obtain insight on current and historical uses of Surf Beach and obtain input on potential long-term solutions. The three groups are San Onofre Parks Foundation, Surfrider Foundation, and San Onofre Surf Club. The other important stakeholder group, the Hawaiian Surf Club, was contacted but a meeting with them was unable to be conducted. The telecom discussions with each of the three groups are summarized below.

San Onofre Parks Foundation

Attendees: Steve Long (Founder and Board Advisor, retired State Parks), Kim Garvey (M&N), Aaron Holloway (M&N), and Jeremy Smith (M&N)

Key Points:

- San Onofre Surf Club pre-dates State Parks management. During that era, an excavation contractor periodically graded and maintained the road and parking area.
- Hawaiian Surf Club is a small, but very important stakeholder; they have been around since the 1970s.
- The three main sediment sources to Surf Beach (San Juan Creek, San Mateo Creek, San Onofre Creek) previously provided a “tremendous” amount of sand and all downcoast beaches benefited.
- Now, San Juan Creek sediment is being excavated upstream and not discharging to the ocean.
- When asked about the history of dredging or sediment management at San Mateo and San Onofre Creeks, Steve said that San Mateo Creek would build check dams for irrigation where farming was present which washed away during the winter months. Had similar El Niño events occurred in 1982-83 and 1998 which were similar to the 2015-2016 event with northwest swell and loss of sand from Surf Beach; however after the previous events, sand returned on Surf Beach from upcoast creeks discharges. These previous El Niño events resulted in wide sand beaches from creek sediment discharges. In contrast, 2005, 2010, and 2015-2016 El Niño events had mild rain which meant less sand inputs. Typically, the system need greater than 6 inches of rain to saturate watershed and contribute sand.
- In the 1960s and 1970s, at Surf Beach, there was a beautiful white sand beach in the summers and a narrow beach in the winter. Now, the beach is narrow year-round.
- Must maintain “spectacular” surfing; any changes to the site should be implemented gradually.
- The emergency revetment did its purpose to protect the road; did not see any effects to surfing from the revetment.
- During the 2015-2016 event, there was severe erosion at Trails; massive amounts of cobble there now. Trails beach only accessible at low tides.
- Not aware of any previous beach nourishment at Surf Beach, except possibly when the Marine Corps built the adjacent resort.

- The five-mile-wide nearshore cobble field creates the surf break from Cottons to Surf Beach.
- At the Point, cobbles affect surf break in shallower water.
- For cobble berm alternative, obtain cobble from south of SONGS, not at Surf Beach.
- Only practical solution is sand nourishment event every five years. Suggest placing sand on Military Beach and letting it wash downcoast.
- People will still come to Surf Beach if they have to park on the bluff-top, but people really like Surf Beach because they are able to park on the beachfront.

Surfrider Foundation

Attendees: Jennifer Savage (Surfrider), Mandy Sackett (Surfrider), Kim Garvey (M&N) and Aaron Holloway (M&N).

Key Points:

- Adam Young from Scripps has done a good study on coastal bluffs.
- Alternatives analysis needs to include effects of armoring.
- For the past four years, sand has accumulated back on beach after winter storms.
- Currently, there is a long wide peak surfing condition; an eroded beach could affect surfing by "bounce back" from the revetment. Also, revetments cause downcoast erosion. Want to make sure State Parks understands the implications of retaining the emergency revetment. Need to educate people so they understand the downsides of armoring.
- Is there a possibility of cutting into the bluff face so as to be able to move the parking area and road landward?
- Would be good to set up working group with all stakeholders to discuss potential alternatives.
- Need to factor in economics, i.e. loss of revenue versus cost of removing the revetment. Refer to a recent conference presentation given by Dave Revell regarding economics of losing a beach.
- Small "groin" exists at the Point now.
- Need to make sure the alternatives analysis looks at all pros and cons.

San Onofre Surf Club

Attendees: Matt Brady (San Onofre Surf Club) and Aaron Holloway (M&N).

Key Points:

- Matt noted that the Board had previously provided a letter to State Parks. This letter is provided in Figure 7.1.

San Onofre Surfing Club
P. O. Box 324
San Clemente, California 92674

March 2, 2018

Dear Superintendent Haydon,

On behalf of the San Onofre Surfing Club Board of Directors I wanted to send a brief note of thanks for all the work that you and your team did last year to keep the beach open. Specifically, regarding the road repairs which were so critical to providing public access, so we could all get to the beach and enjoy the sand and the surf. I hope that our announcements about the construction to the beachgoers was helpful. We understand that some concerns may have been voiced about the repairs that were ultimately installed but as we understand it, the approach taken by your staff seemed to be the best solution. As you know, the club was also very busy dealing with beach erosion challenges as they affected both the shack and the wind vane.

The San Onofre Surfing Club now has a 66- year history at the beach and truly values our 44-year relationship with the State Parks Department at the surf beach. We feel that we are working very well together and we look forward to many more years of keeping this special place an awesome spot for families and surfers alike.

Sincerely,

Matt Brady

Matt Brady
President
SAN ONOFRE SURFING CLUB

FIGURE 7.1: SAN ONOFRE SURF CLUB LETTER TO STATE PARKS

These stakeholder inputs have been used to develop and assess the alternatives herein.

8. Shoreline Management and Adaptation Methods

This section provides an overview of a range of shoreline management and adaptation methods that are potentially applicable to San Onofre Surf Beach. Seven different methods ("Alternatives") were developed.

As required by the California Coastal Commission in Emergency Permit G-6-17-0002, the alternatives "include but are not limited to phased implementation of beach nourishment, soft protection, managed retreat, smaller parking lot area, use of flexible pavers or other paving surfaces that may be more adaptable to beach erosion, narrow-profile armoring, such as a vertical wall, focused or small-scale armoring, and mixed or hybrid options." A description of each alternative is provided in this section. .

8.1. Alternative 1 – Rock Revetment

This alternative consists of retaining the existing 800-ft emergency rock revetment segment in place and constructing additional reaches of revetment as needed (or no further segments at all). The additional rock revetment segments would be constructed in phases as erosion progresses and facilities become more vulnerable. It may be that no additional rock revetment segments are constructed, i.e. that another method is used for the other areas along Surf Beach.

Constructing a rock revetment at Surf Beach is a hard protection strategy that would halt the extent of coastal erosion at the revetment alignment and protect the existing road, parking area and restrooms landward of the revetment. As practical, beach nourishment could be used to bury the revetment and increase the sandy beach width.

The recommended cross-section design for future phases of the revetment would be similar to the existing emergency revetment:

- Crest elevation of +18 ft NAVD88; this is a conservative (relatively high) revetment elevation which results in little or no wave overtopping. A lower elevation could be assessed as part of the next phase engineering design if/when this alternative is selected; the advantage of a lower crest elevation revetment section is its smaller beach footprint.
- Toe depth of 0 ft NAVD88;
- 1.5:1 (H:V) seaward slope:
- 3-5 ton armor stone;
- Two layers of armor stone;
- Facing Class underlayer stone on top of geotextile fabric; and
- Footprint width of approximately 45-50 ft.

The revetment would be located as far landward as possible, along the edge of the parking area so as to minimize loss of sandy beach footprint and impoundment of sand behind (landward of) the revetment. Sand excavated during construction would be placed back on top of the revetment.

A conceptual design of this alternative is provided in Figure 8.1.

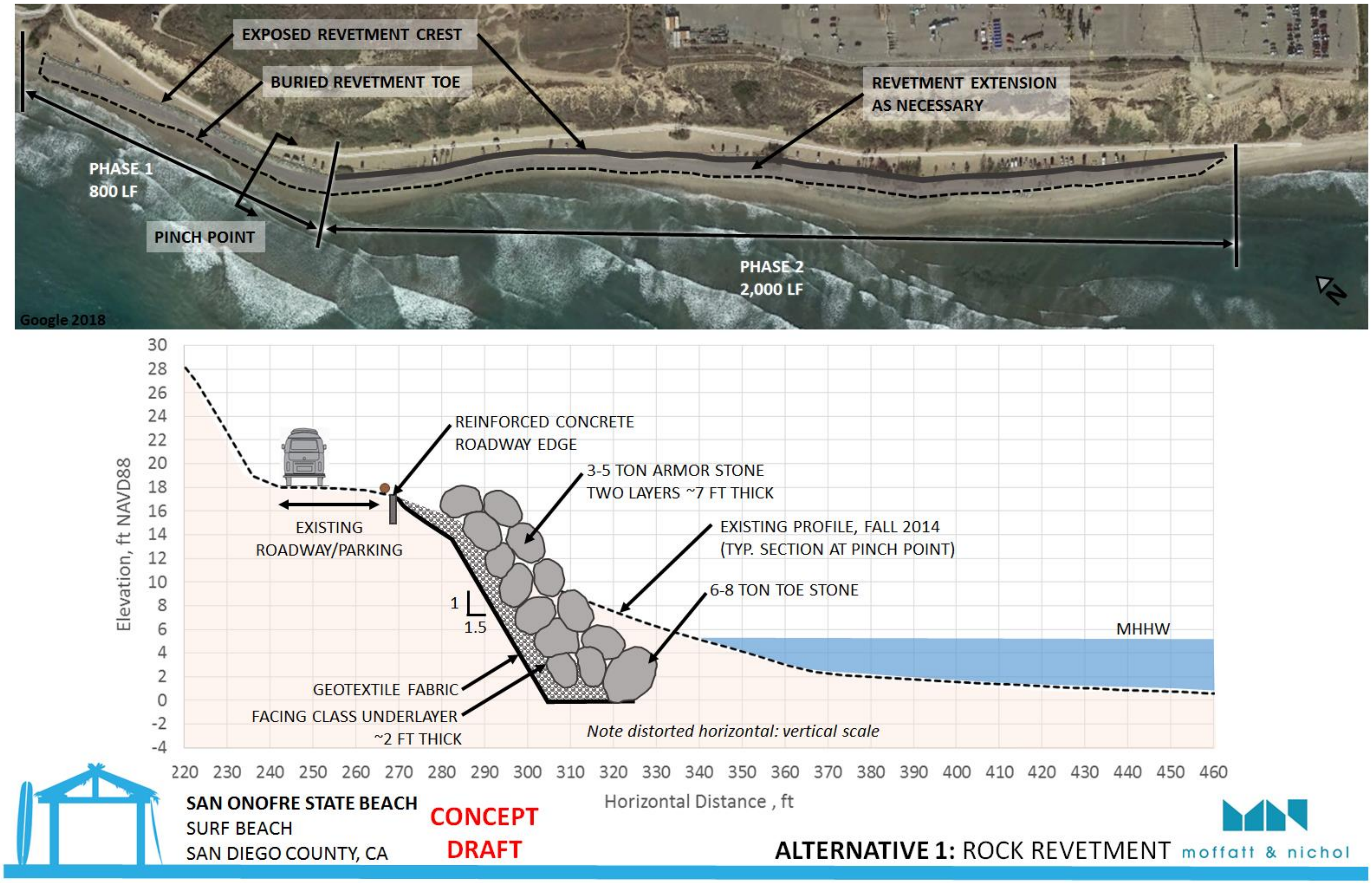

FIGURE 8.1: ALTERNATIVE 1: ROCK REVETMENT CONCEPTUAL DESIGN

If there is a decision to construct additional segments along the shoreline, the entire remaining 2,000 linear feet of Surf Beach shoreline would require a total of approximately 36,000 tons of armor and underlayer rock, based on a conceptual level of design.

In order to enable public access over the rock revetment, concrete stairways could be constructed from the parking lot edge, over the revetment crest and down the revetment's seaward face to/from the beach and water. (See photo, Figure 8.2, for an example public stairway at a beachfront County park in Ventura,).

FIGURE 8.2: EXAMPLE REVETMENT STAIRS – AT HOBSON COUNTY PARK IN VENTURA

8.2. ALTERNATIVE 2 – NARROW FOOTPRINT ARMORING

This alternative is for construction of a vertical wall along the seaward edge of the Surf Beach parking area, in phases, as needed over time. It is similar to the previous rock revetment alternative in that it is a hard protection strategy which would halt shoreline erosion along Surf Beach. However, the wall has a much smaller/narrower beach footprint due to its vertical form.

In this alternative, the existing 800 LF emergency rock revetment would be removed and replaced with the vertical wall. Similar to Alternative 1, additional segments of wall would be constructed along the remaining 2,000 LF of Surf Beach on an as-needed basis.

A conceptual design of this alternative is provided in Figure 8.3.

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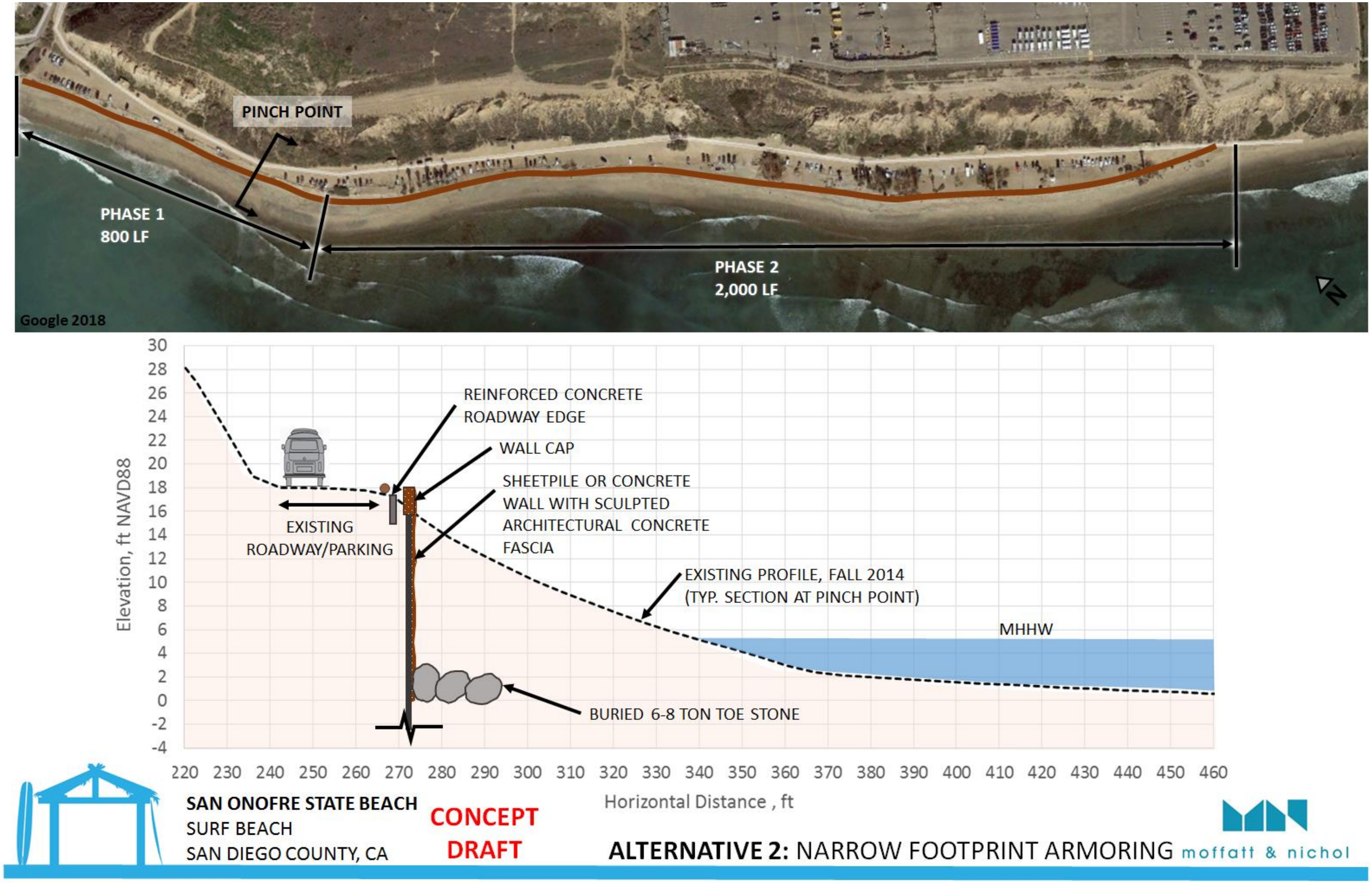


FIGURE 8.3: ALTERNATIVE 2: NARROW FOOTPRINT ARMORING CONCEPTUAL DESIGN

Potential design concepts are to use cast-in-place concrete or steel sheet pile and a beach/bluff-like architectural fascia using sculpted shotcrete. Further geotechnical investigation of the substrate and engineering are required to develop a design which is stable under scour and wave loading conditions.

A similar wall was installed in front of a lifeguard tower on the south end of Cardiff State Beach (Figure 8.4).

FIGURE 8.4: SCULPTED SEAWALL AT CARDIFF STATE BEACH (EXAMPLE OF NARROW FOOTPRINT ARMORING)

Similar to the rock revetment alternative, concrete stairways would need to be constructed to provide public access from the parking lot to the beach, especially when the beach is in an eroded condition.

8.3. ALTERNATIVE 3 – BEACH NOURISHMENT

This alternative consists of placement of imported sand to restore a wider sandy beach and provide protection to State Parks' facilities. The 800 LF emergency rock revetment would remain in place. During the first phase of nourishment, approximately 60,000 CY of sand would be placed to bury the existing emergency revetment and increase the beach berm width to approximately 50 ft. Based on a conceptual level of design, an additional 150,000 CY of beach nourishment would be necessary to increase the beach width along the remaining shoreline without revetment protection. It is expected that the beach will erode during large storm events, the revetment will become exposed and limit further erosion, and thus periodic re-nourishment will be required over time. However, the revetment will serve as a last-line-of-defense protection and limit erosion and damage to the road and parking lot.

A conceptual design of this alternative is provided in Figure 8.5.

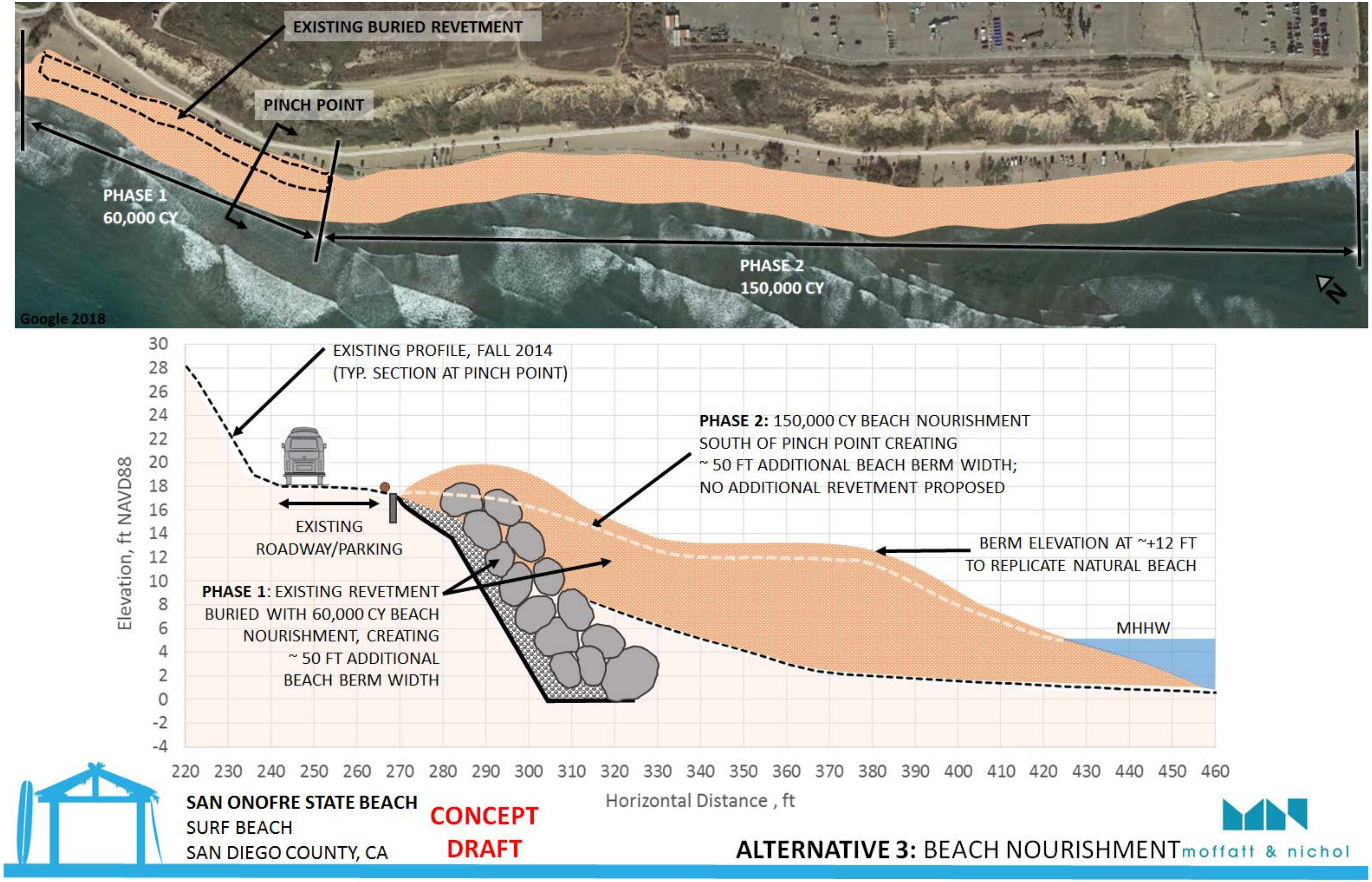


FIGURE 8.5: ALTERNATIVE 3: BEACH NOURISHMENT CONCEPTUAL DESIGN

Several potential sand sources for beach nourishment, as identified in previous studies, are listed in Table 8.1.

TABLE 8.1. POTENTIAL SAND SOURCES FOR SURF BEACH NOURISHMENT

Sand Source Type	Sand Source Location	Previous Study* which Identified Sand Source:
Offshore	Dana Point Offshore	OCRSMP
	Camp Pendleton Nearshore (near Santa Margarita River mouth)	SANDAG CRSMP
	Oceanside Offshore	USACE
Harbors	Camp Pendleton Del Mar Boat Basin	SANDAG CRSMP
	Oceanside Harbor	SANDAG CRSMP
Riverine / Upland (Opportunistic)	Santa Margarita Lagoon	SANDAG CRSMP
	San Onofre Lagoon / Creek	SANDAG CRSMP
	Camp Pendleton	SANDAG CRSMP
	San Mateo Creek	Doheny Study
	Loma Alta Creek	SANDAG CRSMP
	Palisades Reservoir	OCRSMP
	El Toro Reservoir	OCRSMP
	Mission Viejo Lake	OCRSMP

** OCRSMP = Orange County Regional Sediment Management Plan (2015); SANDAG CRSMP = San Diego Association of Governments Coastal Regional Sediment Management Plan (2009); USACE = San Clemente Shoreline Feasibility Study (2009); Doheny Study = Doheny State Beach Long-term Shoreline Alternatives Report (2018).*

Offshore sources generally can provide large volumes of medium-grain-size clean sand, available every 5 to 10 years (SANDAG, 2009). Information on offshore sand sources is available on the California Sediment Management Working Group website. The most likely construction method for the offshore and harbor sources is trailing suction hopper dredge to obtain the sand, hopper dredge transport to a nearshore mono-buoy hook-up off of Surf Beach, and then pumping of sand onshore via pipeline. The distances from the potential offshore and harbor sand source sites to Surf Beach range from 10 to 15 miles. Closer offshore sources may be available; however additional study would be required to identify these areas.

The riverine and upland locations are assumed to be opportunistic sources, i.e. sand from these sources would be available opportunistically as these rivers and reservoirs are being maintained for flood control or other purposes, or from upland construction activities. For these sources, the sand would be trucked to Surf Beach. The distances from the riverine/upland sand source sites (as identified in the table) to Surf Beach range from 10 to 20 miles.

Significant opportunities exist to minimize the initial and ongoing costs of beach nourishment by sharing dredge equipment mobilization and other costs with another partner or utilizing "free" opportunistic sand sources. Examples of these opportunities are the ongoing SANDAG beach nourishment cycles or the future USACE San Clemente nourishment using the Oceanside offshore borrow site.

For any sand source, further study and analyses would be required to assess sand source compatibility with Surf Beach.

Sand placement directly onto Surf Beach would create the widest beach along Surf Beach; however, sand could also be placed along the upcoast Camp Pendleton Resort beach ("Military Beach") to allow for the sand to be naturally transported and dispersed downcoast and into the nearshore. Higher volumes of material would be needed to obtain the desired beach width along Surf Beach for this approach and beach widths cannot be guaranteed due to the dynamic nature of sediment transport along the shoreline.

A preliminary analysis was done in order to estimate the likely required re-nourishment cycle at Surf Beach. The analysis was based on measurements from Google Earth aerial photos at three locations along Surf Beach, (The Point, Old Man's, and Dogpatch), over the period from 1994 to 2018. Beach widths were measured from the bluff toe to the wetted edge. (The berm/scarp edge is not discernable in many of the aerial photos). The winter/spring beach widths were measured for each year during which a winter/spring photo was available; from this, the beach retreat (erosion) rates over the selected time period were calculated. The average retreat/erosion rates were estimated for periods of drought and no drought (excluding values from 2011-2017). Table 8.2 and Figure 8.6 show the results of this analysis. It is important to note that these are averaged rates; erosion along the shoreline is often episodic with large losses in one season.

Based on the analysis and using the location with the highest average rate (5 feet per year), the 50-ft wide nourished beach would need to be re-nourished approximately every 10 years.

Beach monitoring results from the SANDAG beach nourishment projects, which have occurred along bluff-backed beaches in San Diego County, indicate the effects of nourishment are apparent for approximately 5 years before the shoreline retreats and returns to initial conditions.

The lifespan of a beach nourishment is highly dependent on ocean conditions and often beach sand loss is episodic. A moderately likely span along Surf Beach is 5 to 10 years, i.e. re-nourishment would be required along Surf Beach every 5 to 10 years. A storm wave event could occur shortly after a beach nourishment and substantially erode the beach; however, that beach fill would serve as a buffer for the road, parking area, and beach facilities, as has been documented on the east coast during hurricanes.

TABLE 8.2. ESTIMATED AVERAGE BEACH WIDTH RETREAT RATES ALONG SURF BEACH

	Average Retreat Rates (feet per year)		
	The Point	Old Man's	Dogpatch
Drought Years	2	4	5
Non-Drought Years	2	1	4

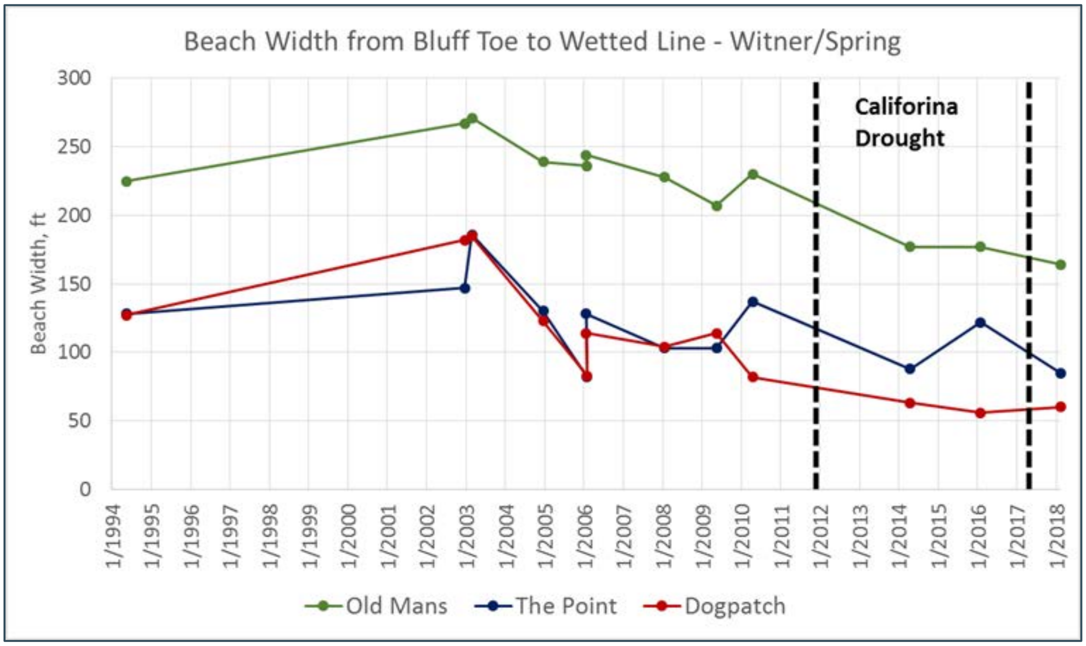


FIGURE 8.6: BEACH WIDTHS ESTIMATED FROM GOOGLE EARTH AERIAL PHOTOS

8.4. ALTERNATIVE 4 – COBBLE BERM

This alternative would bolster the natural shoreline using cobble. The existing emergency revetment would be removed and replaced with a cobble berm. Additional cobble would be placed along the Surf Beach shoreline on an as-needed basis over time.

Cobble berms (a type of “living shoreline”) have been previously constructed in Oregon (Cape Lookout State Park) and in California (Surfers Point in Ventura and Imperial Beach in San Diego). Another is planned for implementation at Cardiff State Beach in 2018-2019. Naturally-occurring cobble berms also exist throughout Southern California, e.g. Del Mar, Cardiff, Batiquitos Lagoon, South Carlsbad, Emma Wood State Beach, and to some extent already along Surf Beach as can be seen in Figure 8.7.

Everts, et al (2002) studied the performance of naturally-occurring cobble berms on beaches to the north and south of the Batiquitos Lagoon inlet (Carlsbad). The cobble berms at these locations showed out-of-phase seasonal fluctuations in sand and cobble. Specifically, during the winter, the sand retreated from the shoreline and the cobble accumulated, whereas the contrary occurred during the summer. The long-term change in the volume of cobbles may be inversely proportional to the volume of sand in the littoral cell. The cobble berm accreted during the strongest El Niño winter in the 20th century and a very intense storm in 1988.

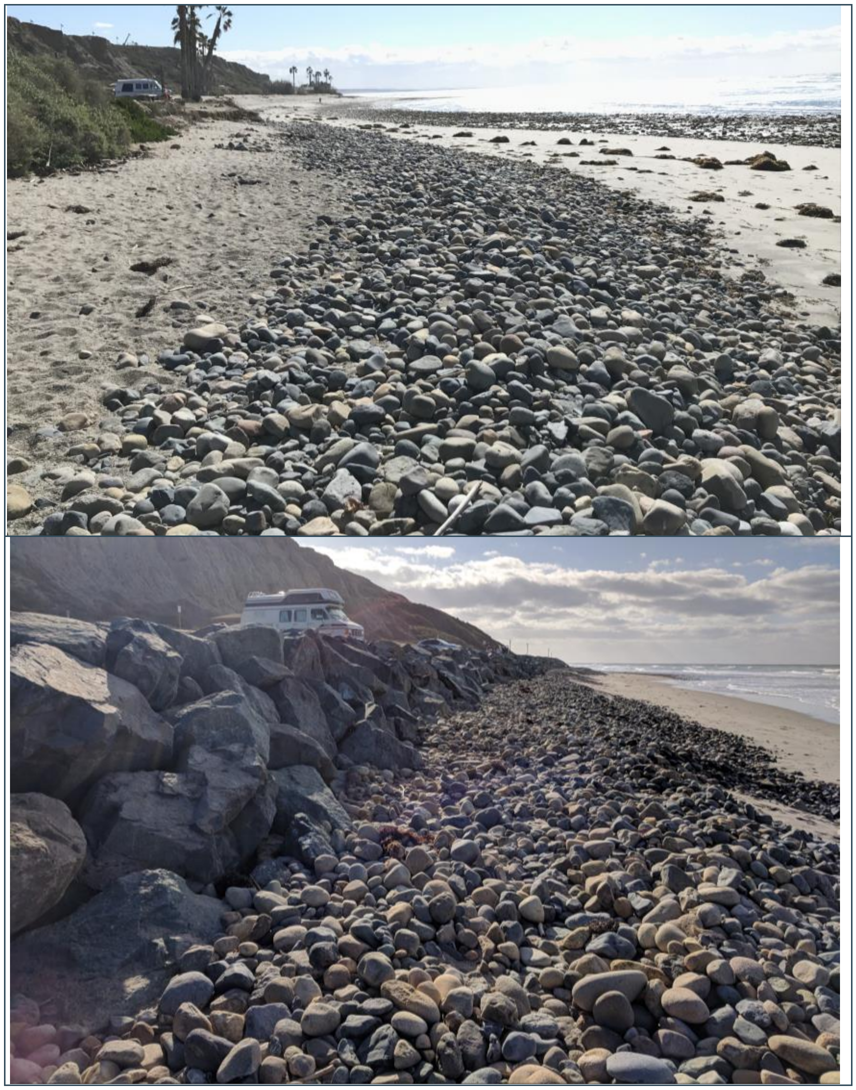


FIGURE 8.7: EXPOSED NATURALLY-OCCURRING COBBLE ALONG SURF BEACH

Although cobble berms have performed well in Southern California, there is a lack of quantitative design guidance for their construction as use for coastal protection on a sandy coast. However, a few design elements have been determined. For example, larger cobble size requires less volume to provide coastal protection due to the decreased tendency to mix with sand. Higher (in elevation) cobble berms provide greater protection from property flooding; however, lower berms allow for some overwash that can be beneficial to stabilization. One way to optimize both flood protection and stability is to increase the width of the cobble berm (Everts, et, 2002).

Another study (Buenaventura 2003) conducted for the Surfers Point project found the following for various cobble berm design elements:

- Cobble size: Berm stability increases with cobble size.
- Size distribution: A more uniform gravel/cobble/boulder (GCB) size is more stable than a wide range of sizes.

- Berm porosity: The berm should be limited to cobbles and/or boulders, without including sand or gravel, to promote water infiltration.
- Crest elevation: Allowance of some overtopping during the most extreme wave events increases the stability of the berm.
- Base elevation of the berm: The lower surface of the berm should be at or below the scour limit of the fronting shore platform. If this scour limit cannot be meet, a scour apron should be placed in front of the berm to prevent undermining.
- Compatibility with sand replenishment: The GCB is not incompatible with sand replenishment; however, the sand should not be placed atop the berm.

The study concluded that a comparatively small volume of cobbles with a relatively small footprint is needed to provide the same level of protection as a large volume of sand.

A conceptual design of this alternative is provided in Figure 8.8. The initially constructed berm would be 80-ft wide with a crest elevation of approximately +8 ft NAVD88 and a toe elevation of 0 ft NAVD88 (assumed scour limit).

Approximately 25,000 tons of cobble are required to construct the 800 LF Phase 1 segment based on conceptual design; an additional 60,000 tons of cobble would be required for the remaining 2,000 LF. The majority of the cobble would need to be purchased and trucked to the site from a sand/gravel supplier. However, the shoreline south of SONGS is a potential source of additional cobble if it can be removed without disturbing marine resources or affecting surf conditions; further investigation would be needed to evaluate this potential source of cobble.

8.5. Alternative 5 – Active Road Maintenance

This alternative is similar to previous operations at Surf Beach, i.e. the road and parking area are left unprotected from coastal erosion and repaired to the extent feasible when damage occurs. The emergency revetment would be removed and the roadway maintained with imported native-compatible materials following erosion events. It is likely that some seaward parking areas would be lost and the road would become narrower over time as sea level rises.

As erosion progresses at the roadway pinch point at the northern end of Surf Beach, more parking areas would be lost. Road maintenance would become more frequent. Year-round road maintenance and thus year-round public vehicular access may not be feasible as the shoreline retreats. Access may only be seasonal, when a wide-enough beach exists. Eventually (2050-2080 based on CoSMoS shoreline erosion projections), access around the pinch point may only be possible at low tide with off-road vehicles and by foot.

This alternative also assumes the need for phased removal of existing restrooms as they are threatened by erosion. Restrooms would need to be removed before the time when maintenance vehicles can no longer access them from the road.

A conceptual design of this alternative is provided in Figure 8.9.

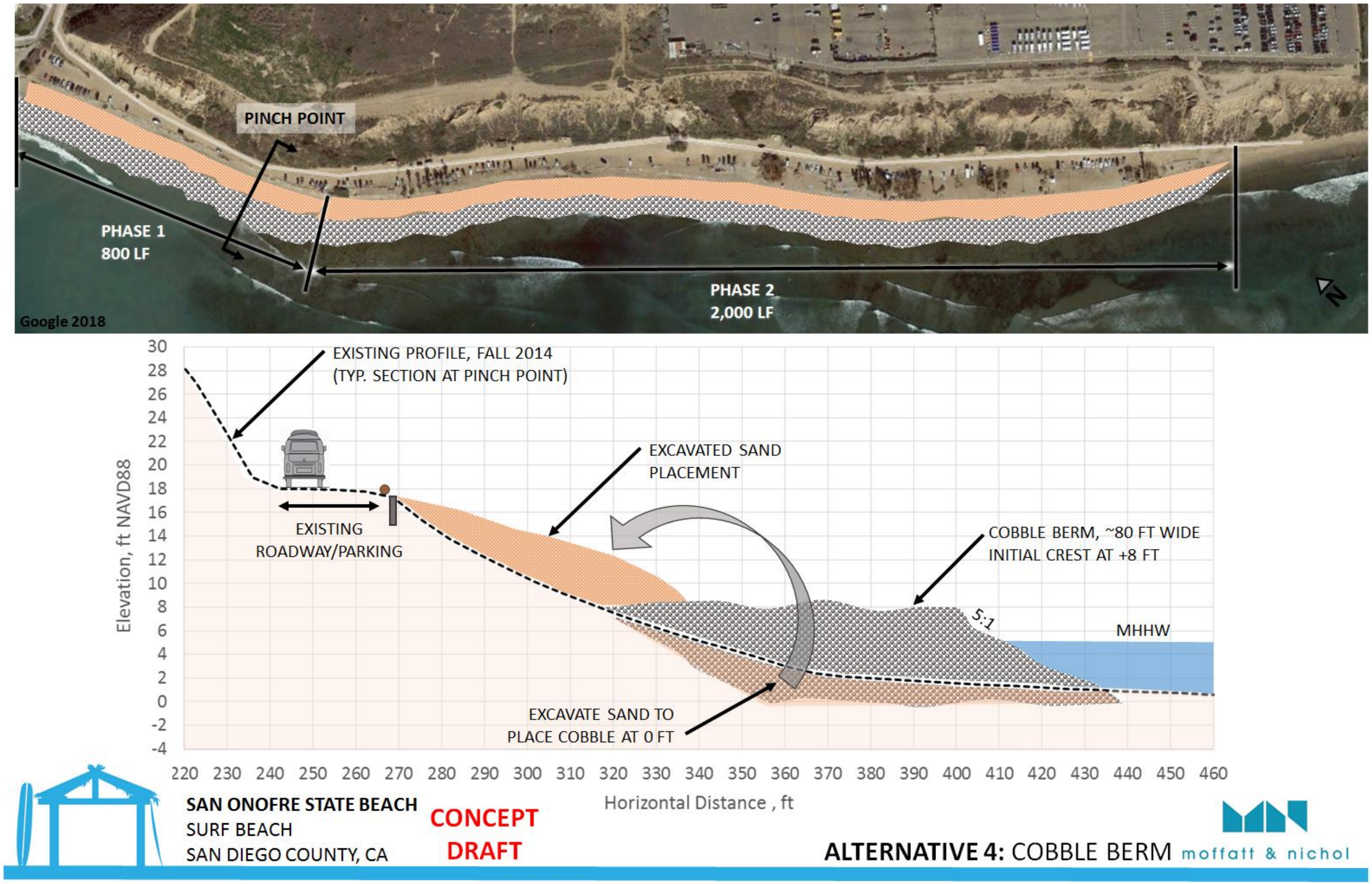


Figure 8.8: Alternative 4: Cobble Berm Conceptual Design

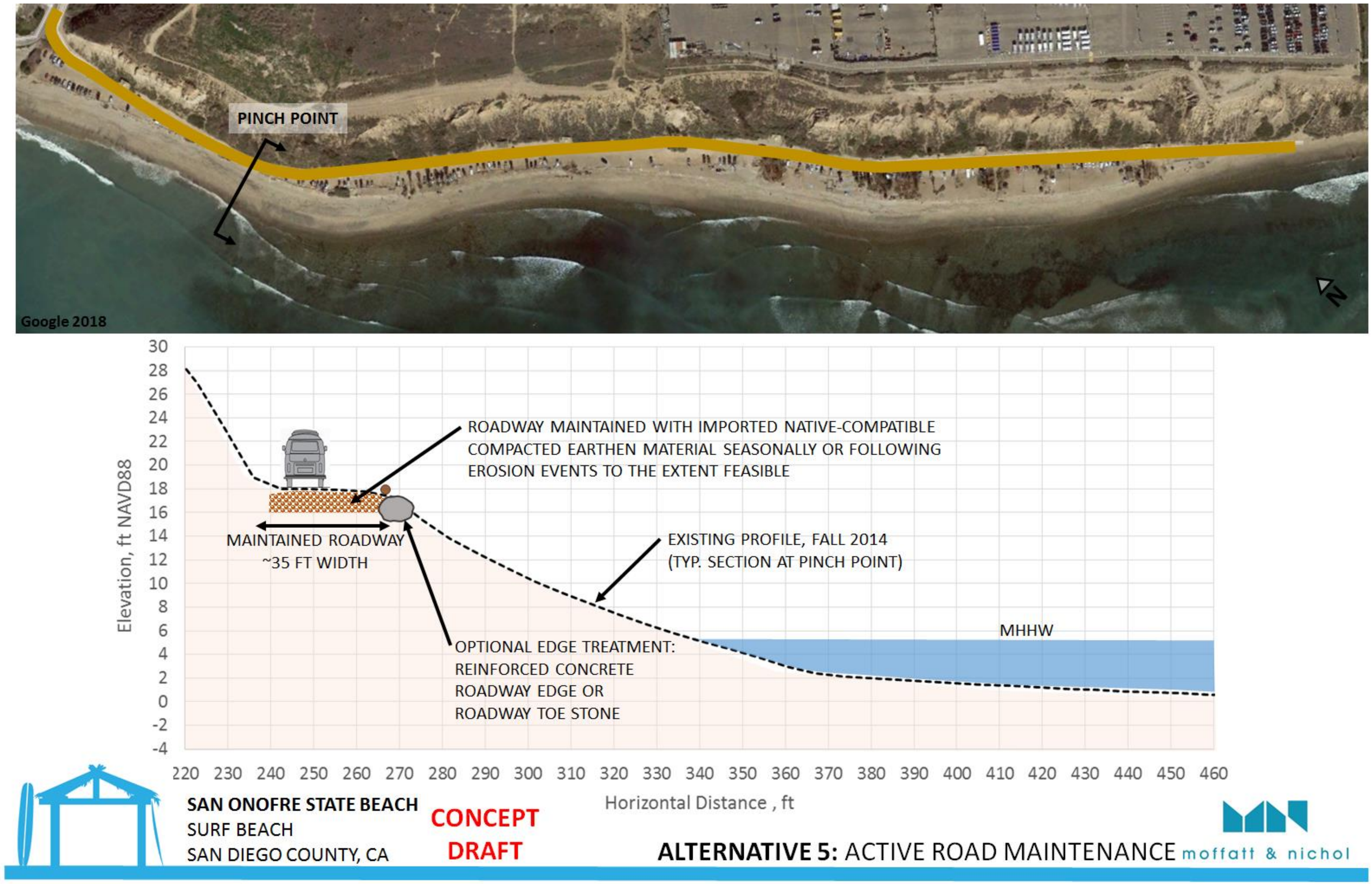


FIGURE 8.9: ALTERNATIVE 5: ACTIVE ROAD MAINTENANCE CONCEPTUAL DESIGN

8.6. ALTERNATIVE 6 – PHASED RETREAT

This managed retreat alternative is intended to provide a phased solution for adapting to future amounts of sea level rise. The basic principal is to move facilities landward as possible as shoreline erosion progresses. Preliminarily, the following phases would be implemented over future time horizons:

- **Phase 1:** The emergency revetment is removed and natural erosion is allowed to occur. As erosion progresses at the roadway pinch point, some seaward parking areas will be lost. Eventually (as early as 2030), public vehicular access around the pinch point may only be possible at low tide, seasonally, or during calm wave conditions.
- **Phase 2 (2030 – 2050):** More beach parking is lost along the entire shoreline as erosion progresses. Public vehicular access around the pinch point is likely limited to the summer season, with frequent maintenance of the pinch point roadway required. The existing beach restrooms will need to be removed and/or relocated as erosion progresses. Restrooms would need to be removed before the time when maintenance vehicles can no longer access them from the road.
- **Phase 2A (2030 - 2050):** As shoreline erosion progresses, an option in this phased retreat alternative is to construct a short-term/temporary retaining wall at the toe of the bluff in the area of the pinch point. This would allow for landward pull-back of the roadway at the pinch point and thus "buy time" for park visitors to be able to use the southern-end road and parking areas until the Phase 3A bluff-top accessways can be implemented. This retaining wall would be constructed in the location of one of the filled barrancas. Even with this bluff-retaining wall and landward pull-back of the road, as erosion continues to progress with further sea level rise, vehicular access around the pinch point may eventually only be possible at low tide seasonally, or during calm wave conditions. Upon implementation of Phase 3 of this alternative, the retaining wall would be removed to allow for natural erosion of the bluffs.
- **Phase 3:** Implement one or both of these beach access improvements:
  - **Phase 3A (long-term option, 2030 – 2100):** Provide a new pedestrian accessway from the bluff-top down to the beach via a maintained earthen foot trail and/or stairway from the northern end of the existing SONGS parking lot. An example of stairways for public access from a bluff-top to the beach is shown in Figure 8.10. State Beach visitors would park in the SONGS parking lot when/if it becomes available and approved by the USMC. Other public parking options include creating parallel parking spots along Beach Club Road and surrounding access roads. An ADA-accessible parking area and vista point would be provided at the bluff top. At least one bluff-top restroom would need to be constructed.
  - **Phase 3B (long-term option, 2050 - 2100):** Construct a roadway down the bluff face to provide access from the bluff-top to the beach. Public parking would be available along the beachfront for as long as feasible. When/if beach parking is no longer feasible, the roadway could be used by park visitors for loading/unloading beach gear on the beach and then returning to the bluff-top to park at the SONGS parking lot when/if that facility becomes available and approved by the USMC. Other parking options include creating parallel parking spots along Beach Club Road and surrounding roads.

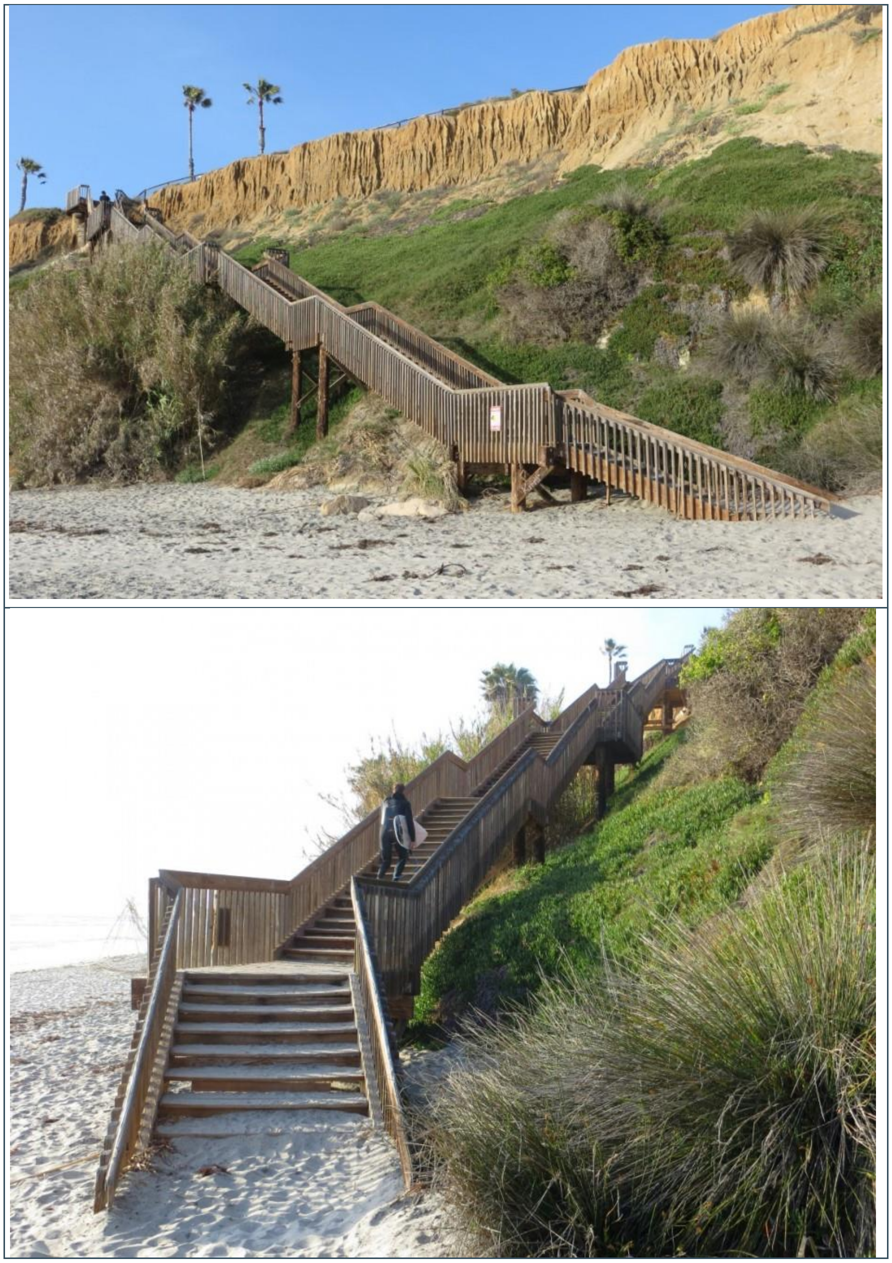
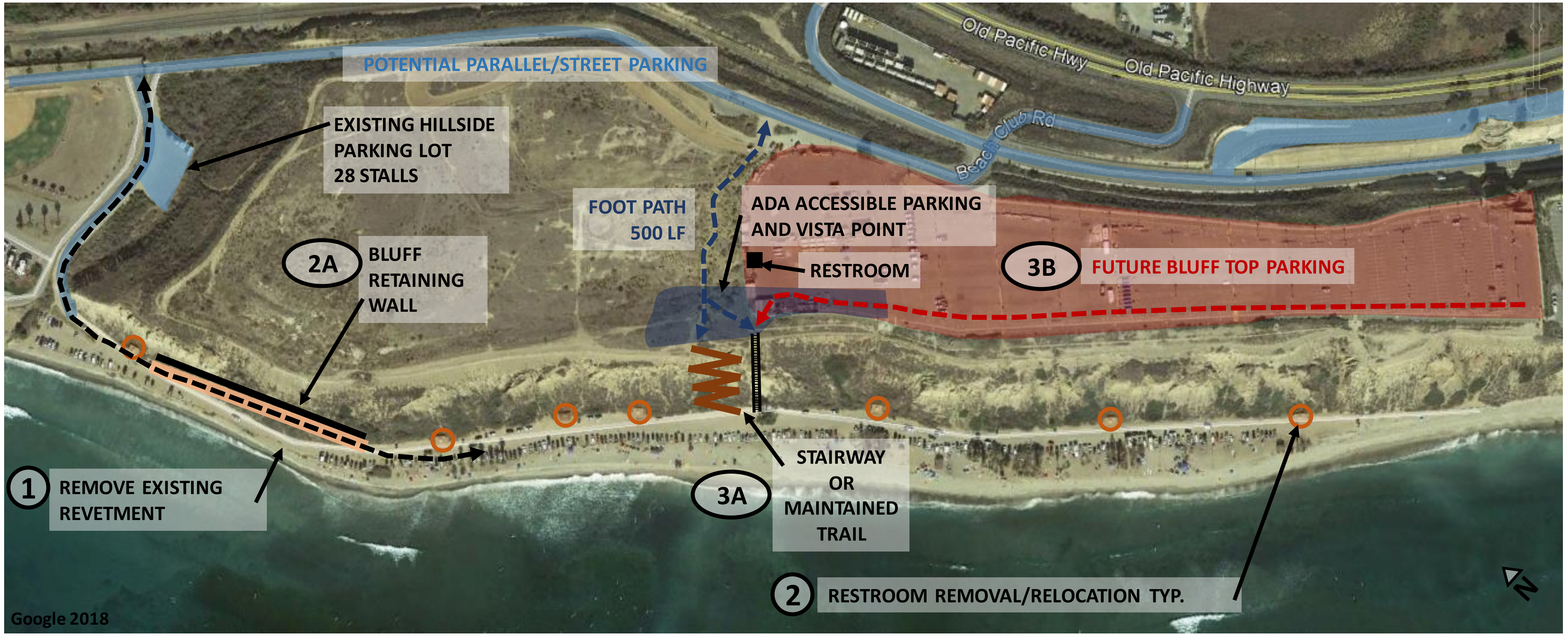


FIGURE 8.10: EXAMPLE BLUFF STAIRWAY - SAN ELIJO STATE BEACH

Graphics of the phases for this alternative are provided in Figure 8.11 and Figure 8.12.

Special attention must be given for addressing erosion and maintenance for this Alternative 6. For the new roadway to be constructed in this alternative, long-term shoreline and bluff erosion must be considered in the design to provide adequate setback. A realistic life-cycle for the road must be determined, along with a long-term plan for maintaining or armoring the base of the roadway as erosion progresses.

It should also be noted that the later phases of this alternative are highly dependent upon the schedule of the SONGS decommissioning and USMC approvals.



PHASE ①: Emergency revetment removed; erosion impacts beach parking and access at pinch point. Some areas may only be passable seasonally, at low tide or with an off-road vehicle. The hillside parking lot and northernmost beach parking would be the only parking option if pinch point is impassable, some vehicles could potentially park along Beach Club Road.

PHASE ② (ONGOING): More beach parking is lost, beach facilities (restrooms) to be removed, relocated or retrofitted for conditions as erosion progresses. Beach facilities must be removed at the point in time when maintenance vehicles will soon no longer be capable of servicing these facilities.

PHASE (2A) (SHORT-TERM OPTION): Maintain existing access ways in the short-term. A bluff retaining wall is constructed at the pinch point to pull back the roadway landward, providing a buffer for erosion.

PHASE (3A) (LONG-TERM OPTION): Provide new pedestrian bluff top beach access near the northern end of SONGS parking lot. Beach access provided via foot path and stairway. A maintained trail along the bluff face could be used in lieu of a stairway. Parking could be in the SONGS parking lot if/when the facility becomes available. Other parking options could include creating parallel/street parking spots along Beach Club Road and surrounding access roads.

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ALTERNATIVE 6: PHASED RETREAT

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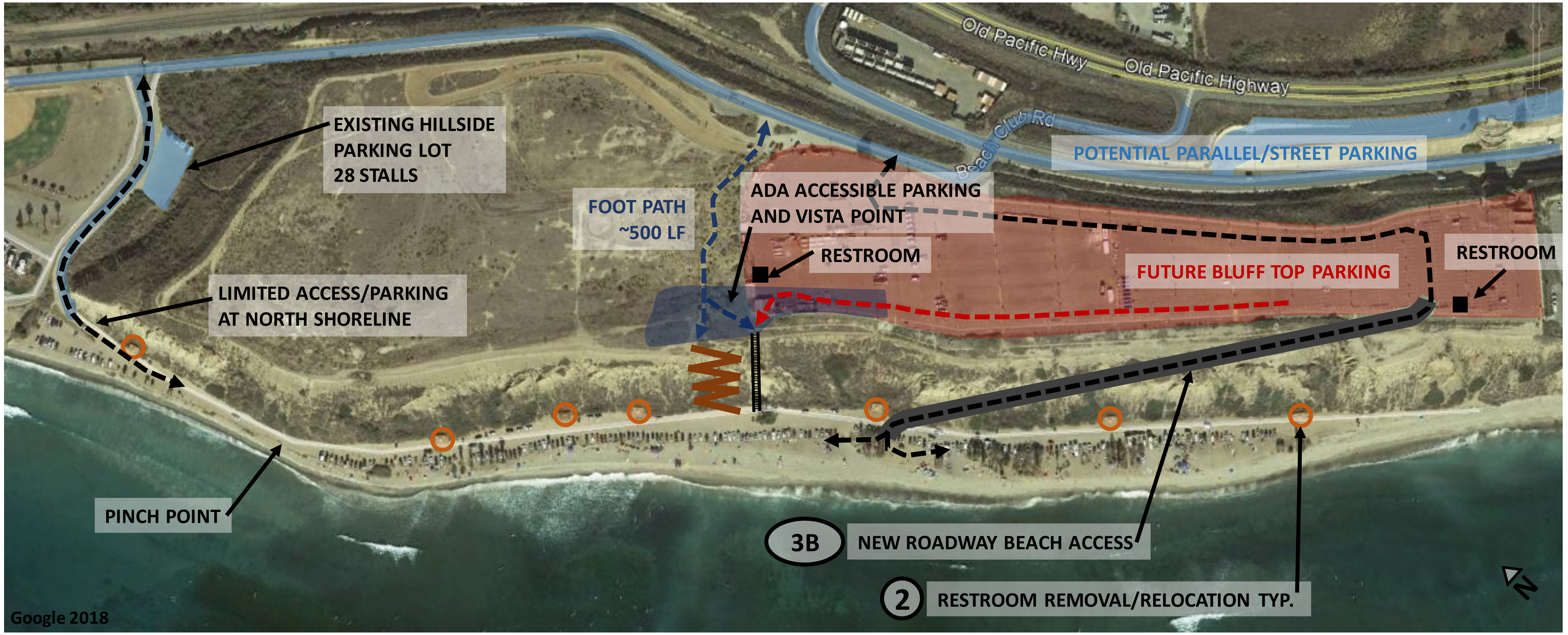
FIGURE 8.11: ALTERNATIVE 6: PHASED RETREAT CONCEPTUAL DESIGN – 1 OF 2



PHASE 3B (LONG-TERM OPTION): Construct a roadway to provide vehicular beach access from the bluff top near the southern end of the SONGS parking lot. Limited parking would be available on the beach for as long as feasible. As beach parking is no longer feasible, the roadway could be used for loading/unloading beach equipment and emergency access. The SONGS parking lot would be used for bluff top parking if/when the facility becomes available. Other parking options could include creating parallel/street parking spots along Beach Club Road and surrounding access roads.

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ALTERNATIVE 6: PHASED RETREAT moffatt & nichol

FIGURE 8.12: ALTERNATIVE 6: PHASED RETREAT CONCEPTUAL DESIGN – 2 OF 2

8.7. ALTERNATIVE 7 – LIMITED ACTION (VULNERABILITY "ASSESSMENT")

This limited action / no build scenario is provided herein to assess the existing State Beach vulnerability to inundation, flooding, and erosion ("Assessment") with no shoreline management/adaptation methods applied. This serves to demonstrate the risks of ongoing shoreline erosion and to better understand and compare the benefits and impacts of the other potential alternatives. The only actions of this alternative are near-term removal of the existing emergency revetment and future removals of beach restrooms as they become vulnerable to flooding and damage.

Similar to the previous alternative, as shoreline erosion progresses, seaward parking areas will be lost and access around the roadway pinch point will eventually (as early as 2030) be limited to low tide, seasonal, and calm wave conditions. As sea levels rise and erosion progresses, more beach parking will be lost and maintenance will increase as shown conceptually in Figure 8.13. At some point in time (estimated as ~2030 in the graph), the maintenance costs will level out and potentially even decrease as it becomes no longer possible to maintain certain areas of the Surf Beach road and parking lot. Restrooms would need to be removed before the time when maintenance vehicles can no longer access them from the road. The existing smaller State Parks' parking lot off Beach Club Road will eventually become the only available parking area for beach access by foot. The reduction in parking spaces over time will result in reduced park visitor revenue as shown in Figure 8.13.

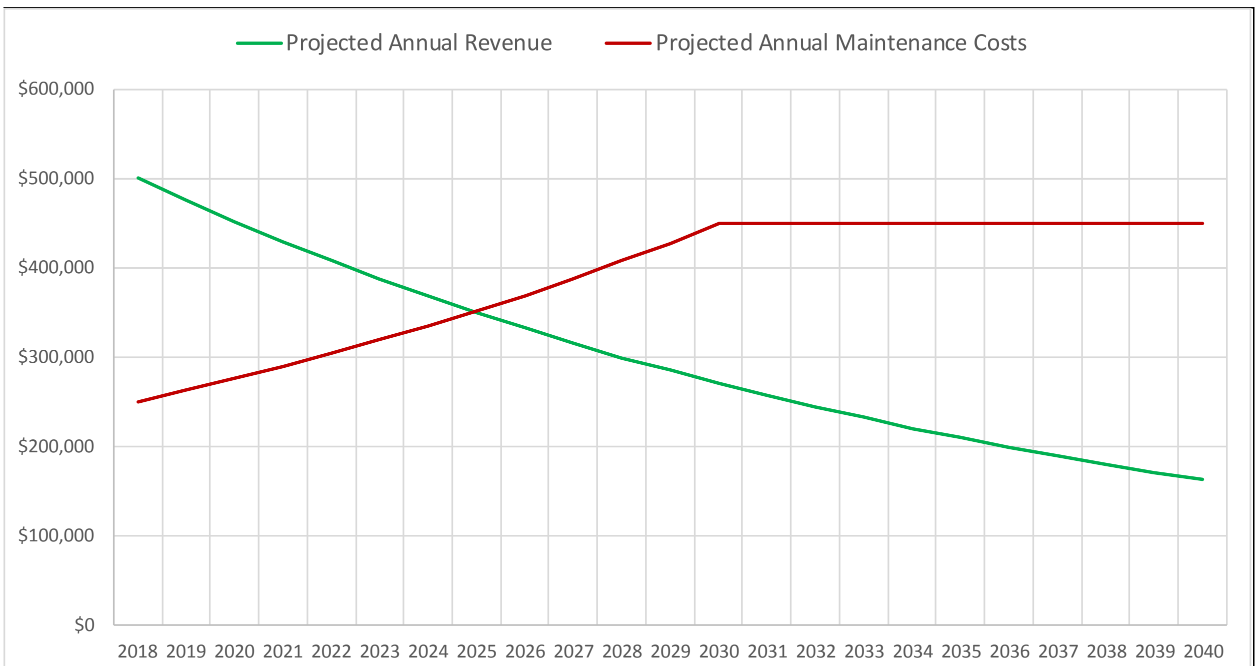
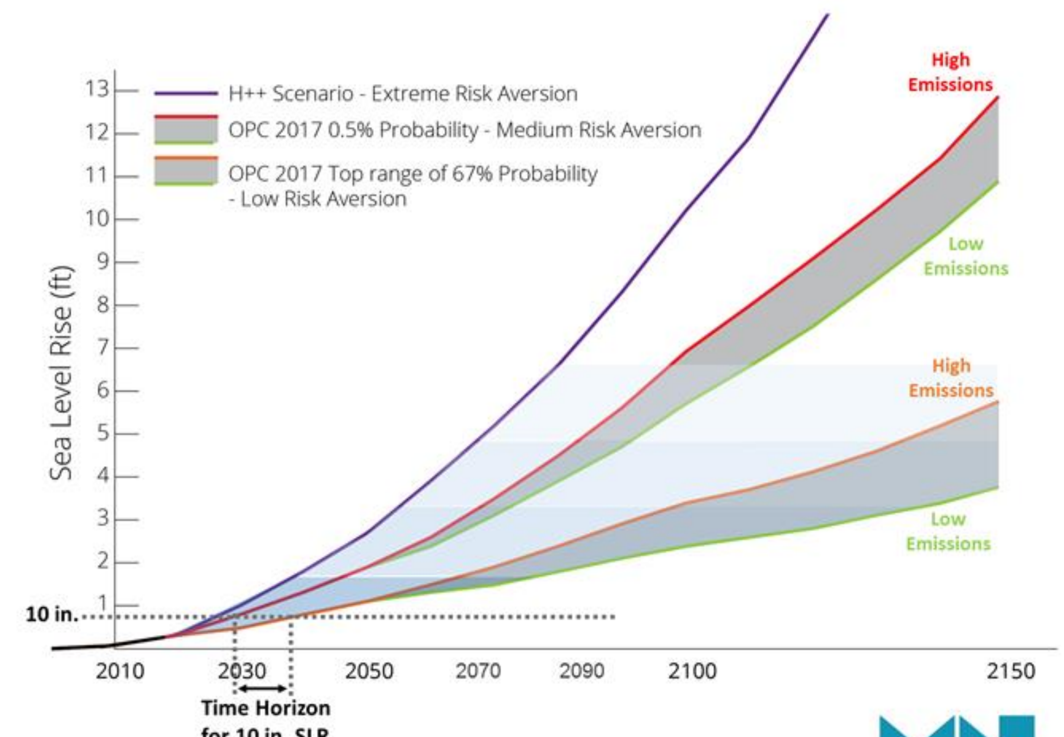


FIGURE 8.13: DECREASE OF PARKING REVENUE AND INCREASE OF MAINTENANCE COSTS OVER TIME

Graphics of the erosion progression and time horizons of this alternative are provided in Figure 8.14 and Figure 8.15.

PHASE①: Emergency revetment removed; erosion impacts beach parking and access at pinch point. Some areas may only be passable seasonally, at low tide, or with an off-road vehicle during calm conditions. The existing hillside parking lot and northernmost beach parking would be the only parking option if pinch point is impassable, some vehicles could potentially park along Beach Club Road.

PHASE②: Erosion progresses and beach parking is extremely limited north of the pinch point. The pinch point is no longer passable, thus beach parking is not accessible to the south and typical facility maintenance vehicles can not access the beach facilities (restrooms). All beach facilities south of pinch point to be removed at the point in time maintenance vehicles will soon no longer be capable of servicing these facilities.



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ALTERNATIVE 7: LIMITED ACTION | 25 cm (10 in.) SLR

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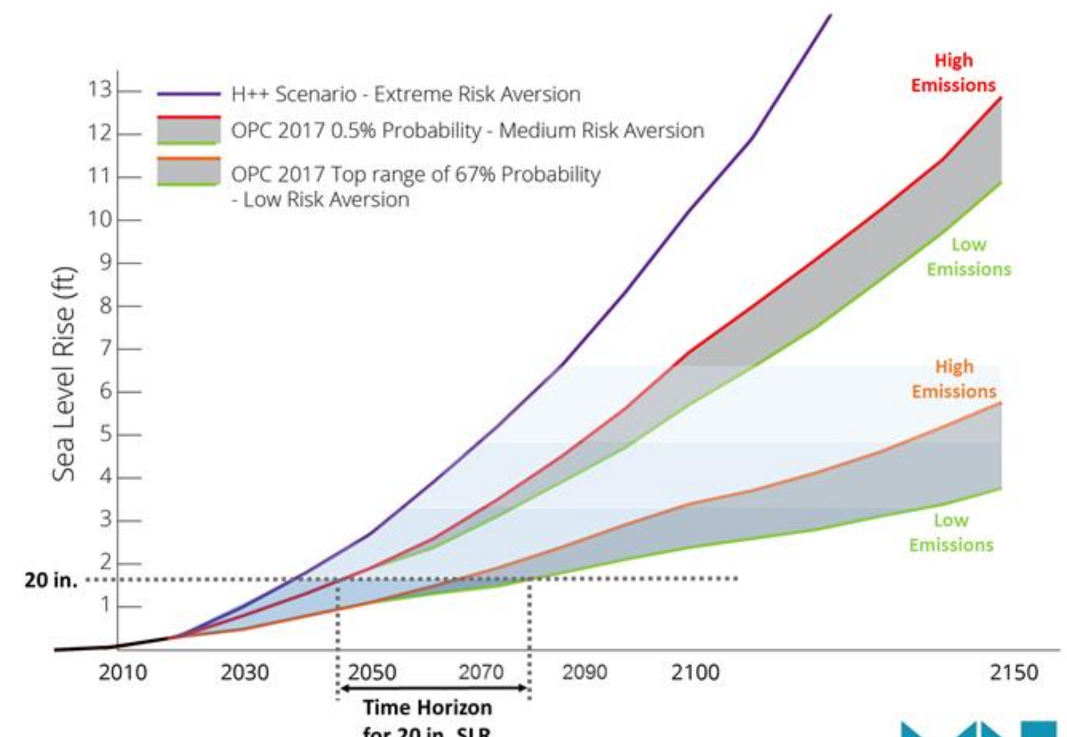
FIGURE 8.14: ALTERNATIVE 7: LIMITED ACTION WITH 0.8 FT OF SEA LEVEL RISE

PHASE 3: Erosion progresses and beach parking is no longer possible along any part of the State Parks shoreline. Beach access is limited to low tide, seasonal, and calm sea conditions. All beach facilities have been removed. The existing hillside parking lot would be the only parking option, some vehicles could potentially park along Beach Club Road.



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ALTERNATIVE 7: LIMITED ACTION | 50 cm (20 in.) SLR moffatt & nichol

FIGURE 8.15: ALTERNATIVE 7: LIMITED ACTION WITH 1.6 FT OF SEA LEVEL RISE

9. Assessment of Alternatives ("Impacts")

An evaluation of each alternative's compliance with State policies, potential impacts and other considerations (coastal hazards, public access and recreation, biological resources, permitting, construction costs, and long-term maintenance) ("Impacts") is provided in this section.

9.1. Compliance With State Policies

The DOM Coastal Development Siting Policy requires special consideration of structural protection alternatives, e.g. Alternative 1 (Rock Revetment), Alternative 2 (Narrow Footprint Armoring), and the bluff retaining wall component of Alternative 6 (Managed Retreat). Although cobble is littoral material (similar to sand), it might also be considered a "structural" protection alternative.

As required by the Policy, the cost of a structural protection alternative over time must be commensurate with the value of the development to be protected. The costs of the structural protection alternatives herein are mainly the initial construction cost and periodic maintenance. The developments to be protected are the: a) State Parks' beach parking area and restroom facilities (and associated revenue from the parking day use fees); b) State Parks' beach road which provides alongshore access for beach users, as well as for SONGS shoreline maintenance activities; and c) the USMC's vernal pools habitat restoration sites on the bluff top. These developments become vulnerable to erosion and flooding over various time horizons, dependent upon actual levels of future sea level rise.

As experienced with previous winter storm events, sections of the Surf Beach parking and road are already vulnerable to erosion and wave overtopping. As previously discussed, with just +0.8-ft of SLR, the CoSMoS model projects that the road at the "pinch point" at the northern end of Surf Beach will lose approximately half of its width and the mean high water (MHW) line will be at the seaward edge of the parking area, or beyond, along most of the remaining Surf Beach shoreline. With +1.6-ft of SLR, the CoSMoS model projects that the road at the "pinch point" will not exist (i.e. the shoreline will be at the toe of the bluff at this location) and the MHW line will be well into the parking area along most of the Surf Beach shoreline. At this point, public vehicle access and use of the southern end beach parking area will cease to exist because vehicles will not be able to get around the pinch point. However, it assumed that off-road vehicle access to the SONGS site would be possible at low tides and calm wave conditions. It is also assumed that surfers would continue to access the water from bluff-top parking. Under the +3.3-ft scenario, the CoSMoS model projects a shoreline position well into the bluff face (100 ft+), i.e. the beach parking area and road would not exist, i.e. there would likely be no ability for maintenance crews to access the SONGS site and the bluff-top vernal pools would be impacted.

The three (or four if cobble is included) structural alternatives provide protection to the loss of these developments (public parking areas, beach access ways, and bluff-top vernal pools) due to ongoing oceanographic conditions and future sea level rise.

The value of the developments to be protected are: a) public recreational opportunity (non-quantifiable but extremely important); b) park fee revenue associated with the parking areas; and c) the economic value related to travel and tourism. The State Parks revenue for San Onofre State Beach (Surf Beach, Trails, and San Mateo campgrounds) is approximately $1,500,000 per year. Assuming the Surf Beach annual revenue component is currently one-third of this amount (i.e. $500,000) and based on the estimated construction costs for the various structural protection alternatives (provided in a following section), 7 to 20 years of this current revenue would be commensurate with the range of costs of the structural alternatives. In other words, 7 to 20 years of Surf Beach revenue would pay for the cost of a structural shoreline protection alternative.

Without the implementation of a shoreline protection alternative, Surf Beach revenue will likely decline as the number of parking spots and thus number of visitors declines. Additionally, as wave damage continues to increase over time, Surf Beach maintenance costs will increase. Figure 8.13 in the previous section demonstrates this concept. At some point in time, maintenance cost will exceed revenue until an alternative can be implemented which restores parking area and thus restores revenue from Surf Beach visitors.

Shore & Beach (Houston, 2018) provides the latest facts regarding the economic value of beaches, as part of the travel and tourism job market. Surveys show that beaches are by far the leading U.S. vacation destination. In the United States, beach tourism supports 2.5 million jobs, generates $45 billion annually in taxes, and returns $230 in federal taxes for every $1 the federal government spends on beach nourishment. It is expected that expenditures to protect and preserve San Onofre State Beach would result in similar return on investment to the State and local economies. Revell (2018) cites that some surf spots in Ventura generate a total recreational value of $20 million a year.

The DOM calls out use of “natural-appearing methods” for shoreline protection; any of the potential structural protection alternatives can be coupled with beach nourishment to fully or partially bury the structures to provide a more “natural-appearing” solution and minimize/avoid any potential deleterious effects from the presence of the structures.

The DOM policy requires that structural protection “will not negatively affect the beach or the near-shore environment.” Alternative 1 (rock revetment) will occupy a beach footprint of up to 50 feet wide; this impact is minimized when sand covers the revetment either from natural sand movement or from beach nourishment. Alternative 4 (Cobble Berm) will occupy a wider beach footprint than Alternative 1, however use of cobble in this alternative is consistent with cobble that occurs naturally along Surf Beach’s intertidal and nearshore environment. Alternative 2 (Narrow Footprint Armoring) will occupy a small footprint, but may have negative effects on the beach and nearshore environment from wave reflection when it is in an exposed condition.

Both the OPC 2018 guidance and CNRA 2018 recommend strategies which consider managed retreat, i.e. Alternative 6 (Phased Retreat), Alternative 7 (Limited Action) and, to some extent, Alternative 5 (Active Road Maintenance). CNRA 2018 cites use of managed retreat to allow for inland retreat of coastal habitats. Alternatives 6 and 7 would ultimately remove State Parks facilities thus providing opportunity for tidal habitat to retreat landward, but tidal habitat would be ultimately constrained by the bluffs with future sea level rise.

OPC 2018 also cites preservation of public access; all alternatives except for Alternative 7, preserve public access, either by protecting the existing public parking areas or by relocating parking and public accessways.

9.2. Coastal Hazards Analysis

The hazards associated with this study are the potential damages to State Parks facilities, as well as downcoast beaches, and risks to public safety during storm wave events. Public safety issues can also result from eroded beach conditions in which safe vertical access to and from the beach can be impacted.

These hazards are addressed for each of the alternatives in Table 9.1 below.

Table 9.1. Potential Coastal Hazard Risks for Each Alternative

Alternative	Risks to State Beach Facilities (Based on Wave Runup Analysis Results Provided Below)	Risks to Downcoast Beaches	Risks to Public Safety
1 – Rock Revetment	Lowest Risk - Provides last-line-of-defense protection to State Parks' facilities as erosion progresses and sea levels rise. The revetment crest elevation can be raised to accommodate SLR.	Some risk to downcoast beaches by impoundment of sediment behind the revetment and local passive erosion effects from discontinuous protection (discussed further in Section 9.2.2). Impacts to the beach fronting the existing revetment segment appear to be minimal, if any, as sand has accreted in front of the revetment since its installation.	Low Risk – maintains current road widths for safe public access along the shoreline. Stairs included to provide safe public access over the revetment to/from the water.
2 – Narrow Footprint Armoring	Medium Risk - Provides last-line-of-defense protection to State Parks' facilities as erosion progresses and sea levels rise. A cap can be added to the top of the wall to raise its elevation to accommodate SLR.	Some risk to downcoast beaches by impoundment of sediment behind the wall and local passive erosion effects from discontinuous protection (discussed further in Section 9.2.2). Wave reflection and resulting local erosion is the most significant risk of this alternative.	Low Risk – maintains current road widths for safe public access along the shoreline. Stairs included to provide safe public access over the seawall
3 – Beach Nourishment	Low Risk - Provides protection against coastal hazards assuming sand beach width is maintained over the long-term.	None. Contrarily, this alternative provides benefit to downcoast beaches by delivering additional sand via natural littoral processes.	Low Risk – maintains current road widths for safe public access.

Alternative	Risks to State Beach Facilities (Based on Wave Runup Analysis Results Provided Below)	Risks to Downcoast Beaches	Risks to Public Safety
4 – Cobble Berm	Low Risk - Provides protection against coastal hazards assuming cobble berm width is maintained over the long-term.	It is assumed that the cobble will not impound sand. The only potential risks are local passive erosion effects when the cobble is pushed up the beach face at a steeper slope. Potentially causes local scouring from cobble movement during large wave events.	During storm and large wave events, public access may need to be limited due to the risk of air-borne cobble. Public access to the water may be more difficult due to walking on cobble.
5 - Active Road Maintenance	High Risk – In the near-term, it is likely that parking spaces will be lost and the road will become narrower. Eventually, as sea level rises, the road and parking cannot be feasibly maintained.	None, assuming any infrastructure and debris is removed prior to erosion losses, the beach, parking area and road will be subject to natural erosion patterns.	Assuming a narrower road, during storm and large wave events, public access will need to be limited (similar to existing road closure practices) due to the risk of wave overtopping and hazardous conditions.
6 – Phased Retreat	High Risk – In the near-term, it is likely that parking spaces will be lost and the road will become narrower. The bluff retaining wall will buy time for public use of southern end parking areas, but eventually, as sea levels rise, the road and parking cannot be feasibly maintained. However, a new public parking lot will be constructed on the bluff-top.	None, assuming any infrastructure and debris is removed prior to erosion losses.	Assuming a narrower road, during storm and large wave events, public access may need to be limited (similar to existing road closure practices) due to the risk of wave overtopping and hazardous conditions.
7 – Limited Action	Highest Risk – In the near-term, it is likely that parking spaces will be lost and the road will need to become narrower. Eventually, as sea levels rise, the road and parking will not be lost.	None, assuming any infrastructure and debris is removed prior to erosion losses.	Assuming a narrower road, during storm and large wave events, public access may need to be limited due to the risk of wave overtopping.

9.2.1. Potential Wave Hazards

Wave hazard risks to State Beach facilities can be quantified with wave runup and overtopping analyses for each alternative. Due to the known vulnerability of the site from past erosion and flooding events and the FEMA study's predicted flooding up to the bluff toe even under the smallest event (10-year return period wave), an annual (1-year) wave event was selected to analyze each alternative. Current and future SLR conditions were analyzed. The +3.3 ft SLR scenario was not analyzed as CoSMoS modeling (section 5.3.2) indicates the shoreline will have moved landward well into the existing bluff face with 3.3 ft of SLR and thus it is not likely that any shoreline protection alternative without beach nourishment would be practical at that level of SLR.

The annual (1-year) wave event selected from the CoSMoS wave modeling results is shown in Figure 9.1. The wave height was selected from an area just offshore of the beach area, shown with a red bracket in Figure 9.1. The wave period was obtained from the Camp Pendleton nearshore wave buoy (NOAA Station 46242) from waves with similar significant wave heights to the annual event. The still water level was obtained from the NOAA statistical water level analysis for an annual event at the La Jolla tide gage (Table 5.2).

Annual event wave parameters:

- Significant Wave Height (H_s): 6.6 ft (2.0 m)
- Wave Period (T_p): 16 seconds
- Still Water Level (SWL): 2.6 ft (0.77 m) NAVD88
  3.3 ft (1.02 m) NAVD88, with +0.8 ft SLR
  4.2 ft (1.27 m) NAVD88, with +1.6 ft SLR

The wave runup methodology outlined in *EurOtop Wave Overtopping of Sea Defences and Related Structures: Assessment Manual* by Pullen, et al. (2007) was used for the analysis. This document represents the most recent and comprehensive manual for calculating runup elevations and overtopping (mean discharge) rates.

The results of the analysis for each of the alternatives, for three sea level rise scenarios, are shown in Table 9.2; the calculated wave runup elevations are shown, along with the overtopping (mean discharge) rates in liters/second per meter (l/s/m). Higher runup elevations and overtopping rates correlate with greater damage to State Beach facilities from flooding and erosion. Detailed calculations are included in Appendix E.

The runup calculations are based on a beach transect at The Point, which is the narrowest and steepest portion of Surf Beach. The annual event runup calculation for the retreat alternative is similar to the FEMA 10-year event runup calculation, which uses transects farther upcoast and downcoast of The Point where the beach is wider and has flatter slopes.

State Parks closes the roadway and beach parking area during wet weather and high surf conditions; this practice should continue for any selected alternative to provide for pedestrian safety. The EurOtop manual provides the following guidance for tolerable overtopping (mean discharge) rates:

- Pedestrians with a clear view of the sea: 1 l/s/m (0.01 cfs/ft)
- Parked vehicles: 10-20 l/s/m (0.1 to 0.2 cfs/ft)

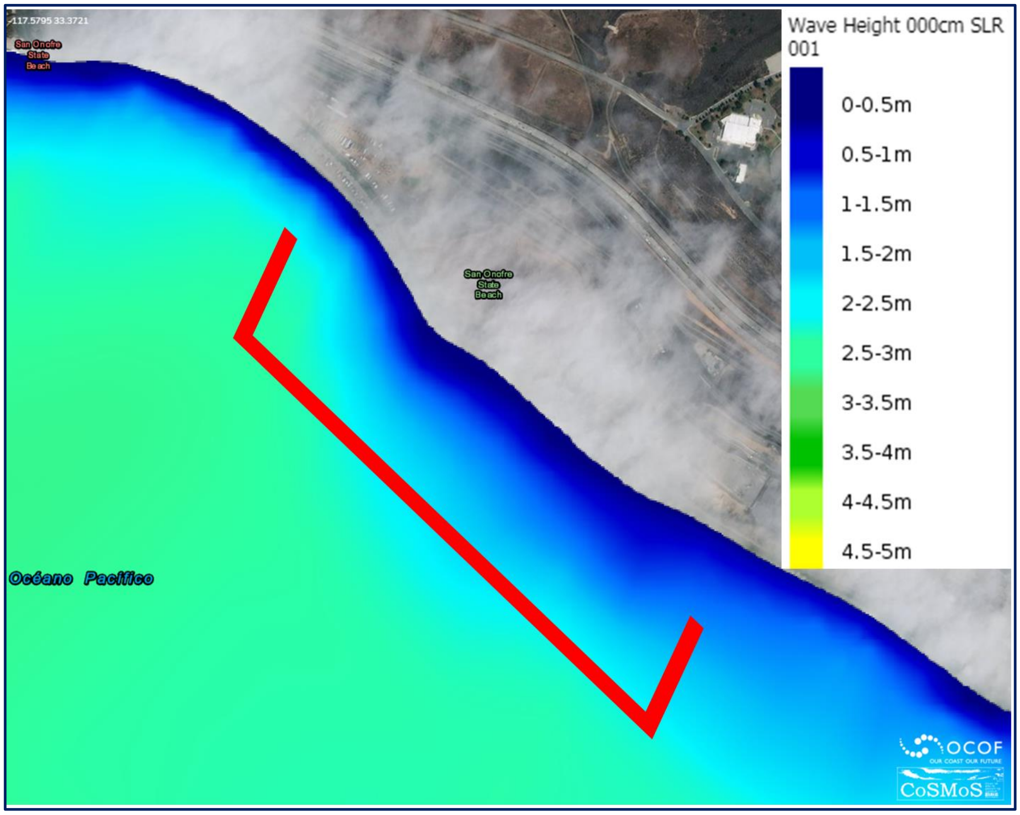

FIGURE 9.1: COSMOS WAVE MODELING RESULTS – ANNUAL EVENT *(OCOF 2018)*

TABLE 9.2: ESTIMATED WAVE RUNUP AT THE POINT, FOR EACH ALTERNATIVE, FOR ANNUAL (1-YEAR) WAVE EVENTS

Alternative	No SLR		+0.8 ft SLR		+1.6 ft SLR	
	Runup Elev (ft, NAVD88)*	Over-topping Rate (l/s/m)	Runup Elev (ft,NAVD88)*	Over-topping Rate (l/s/m)	Runup Elev (ft,NAVD88)*	Over-topping Rate (l/s/m)
1 – Rock Revetment	13	0	14	0	15	0
2 – Vertical Wall	23	8	24	10	25	14
3 – Beach Nourishment **	15	0	15	0	16	0
4 – Cobble Berm	15	0	15	0	16	0
5, 6, 7 – Retreat / No Build	20	3	21	5	22	7

** For reference, the existing road/parking area elevation ranges from +15 to +18 ft NAVD88.*
*** beach profile used in runup analysis based on profile shown in Figure 8.5.*

The wave runup results above show:

- Flooding of the Surf Beach road and parking lot will likely occur at the Point area on an annual basis for the scenarios in which no shore protection is in place (Alternatives 5, 6, and 7).
- In contrast, Alternatives 1 (Rock Revetment), 3 (Beach Nourishment), and 4 (Cobble Berm) provide protection from wave runup and overtopping over the range of future sea level rise.
- The rock revetment alternative provides the greatest protection for wave runup from its higher crest elevation and with wave energy being dissipated on the permeable rock slope.
- Although the crest elevations of the sand and cobble berms are not as high as for the rock revetment, the cobble and sand berms provide a wide, flat rough surface which dissipates wave energy and limits wave runup and overtopping. The cobble berm is expected to remain relatively stable over time, with some seasonal fluctuations; however, the protection provided by the beach nourishment will diminish over time as the sand erodes and thus sand maintenance will be important.
- The wave runup and overtopping is highest for the vertical wall because the wall directs wave energy upward; however, the vertical wall design could be modified to include a recurved top to lower the amount of overtopping.

9.2.2. Potential Structure-Induced Erosion Hazards

It is also important to evaluate whether the alternatives themselves increase local and downcoast erosion. Griggs (2010) identifies several types of effects that are usually identified with the emplacement of coastal armor. These include: visual impacts, loss of beach footprint from placement, reduction of beach access, loss of sand supply from eroding bluffs/cliffs (impoundment), passive erosion and active erosion. The first three impacts are discussed in other sections. The latter three items, which relate to erosion, are discussed below:

- Impoundment. The shoreline protection structures Alternative 1 (revetment) and Alternative 2 (wall) will be located as far landward as possible and thus the existing beach sediment impounded behind (landward) of these structures will be minimized. Both of these alternatives, as well as the bluff retaining wall of Alternative 6, will impound upland and bluff sediment. The extent to which this loss of bluff material supply impacts the littoral supply is based on the amount of beach-compatible material found within the bluffs. Young, et al, 2013 cites that the bluffs along the Marine Corps Base Camp Pendleton (including Surf Beach) range in sand content from 62 to 72%.
- Passive Erosion. Whenever a hard structure is built along an eroding coastline, the shoreline will eventually migrate landward on either side of the structure. (This is also known as discontinuous protection). The effect will be gradual loss of the beach in front of and to either end of the seawall or revetment as the water deepens and the shoreface profile migrates landward. This process is designated as passive erosion and has been well documented along many different shorelines. Passive erosion takes place regardless of the type of protective structure emplaced. This process is perhaps the most significant long-term effect of shoreline armoring (Griggs, 2010). It should be noted that the current condition of the shorelines immediately downcoast of Surf Beach is comprised of narrow

wet sand and cobble beaches and the SONGS seawall/revetment with no beach, i.e. the downcoast beaches are already armored and eroded to a certain extent. Additionally, the revetment or wall alternatives will usually be at least partially buried, in which case, these end effects will be minimized. For any alternative implemented, local and downcoast shoreline monitoring should be implemented to monitor any erosional effects.

- Active Erosion. Active erosion is the potential for coastal armoring to induce or accelerate beach erosion. Griggs, et al (2010) performed an 8-year study to evaluate this effect in California. Local scour was observed at the downdrift end of structures, as a result of the wave reflection from the angled end section of a seawall. The extent of the scour ("usually only a few to perhaps tens of meters in downcoast length") is controlled by the end section configuration. However, the study concluded that there were no distinguishable differences between the winter or the summer profiles for the seawall and the adjacent control beaches, i.e. no increased erosional effects from the seawalls.

In addition, the U.S. Army Corps of Engineers Coastal Engineering Manual (Part V, Chapter 3, Section 2, c) discusses coastal armoring structures and their impacts on laterally adjacent beaches. The Coastal Engineering Manual is considered one of the guiding design documents for coastal engineering practice in the United States. The manual acknowledges early works that documented flanking erosion, however continues citing numerous sources rebutting the existence of end-wall flanking effects. The following bullets are an excerpt from the Coastal Engineering Manual (V-3-2-c, Page V-3-33):

- *Griggs et al. (1997) discuss eight full years of field monitoring including the intense winter storm of January 1995. This storm did not produce end scour on the control beach at Site No. 4. They concluded from a comparison of summer and winter beach profiles at beaches with seawalls and on adjacent, control beaches, that no significant long-term effects were revealed.*

- *Basco et al. (1997) summarize the results of 15 years of profile survey data with 8-9 years taken before seawall construction at Sandbridge, Virginia, on the Atlantic Ocean. The shoreline has been eroding on average 2m/year (Everts, Battley, and Gibson 1983) long before wall construction began. One part of the study used five years of monthly and post-storm profile data at 28 locations (62 percent walled; 38 percent non-walled) of the 7,670 m study reach. They concluded that the volume erosion rate was not higher in front of seawalls. However, seasonal variability of sand volume was slightly greater in front of the walled locations. Winter waves drag more sand offshore in front of walls, but summer swell waves pile more sand up against walls in beach rebuilding. Walled sections recovered about the same time as non-walled beaches for both seasonal transitions (winter to summer) and following erosional storm events. These results were for a weighted average of total sand volume (subaerial) in front of the walled section and seaward of a partition for the non-walled beach sections. At individual profile locations adjacent to walls, using the full 15 years of data, Rv values varied considerably. The evidence for any long-term, end-of-wall effects were considered inclusive for Sandbridge beach. There was never evidence of flanking effects after storms on adjacent beaches (Basco et al. 1997). This study continues. In general, Basco et al. (1997) have confirmed all the conclusions of Dean (1987), Kraus (1988) and Kraus and McDougal (1996) except the end-wall, flanking effect.*

9.3. SURFING

As previously discussed, San Onofre Surf Beach is an extremely popular surf spot and thus it is important to evaluate the various alternatives' potential impacts on surfing.

9.3.1. "The Waves"

The location of the three surf spots along Surf Beach are shown in Figure 9.2 below.

FIGURE 9.2: SURF BEACH SURF SPOTS

Existing conditions for surfing along Surf Beach are described below as copied from the Solspot website (Wright, 2018).

"Sometimes the problem with a surf break that people have been surfing for close to 90 years is that it has like a hundred names. Each generation and clique of surfers has a different name for each spot and sometimes each section of the reef. As you can imagine it gets pretty confusing.

Generally the surf area north of the power plant, where you can actually drive up and park close to the sand, is known as Old Man's.

Old Man's is a pretty large stretch of water with several different peaks that set up and break throughout the line-up. Each of these peaks/areas have their own name. The northernmost peak is known as The Point, the middle area is called Old Man's, and the southern peak is Dog Patch. There is actually another semi-sort of surf area that is further south than Dog Patch referred to as Horseshoes.

The peaks are actually formed by a rocky cobblestone reef that extends a ways off the beach, which is probably leftover from some historic beachside bluff erosion of the Arroyo San Onofre waaaaay back in the day. The reef is generally flat with smooth rocks covered in a mix of sand and sea grass. The individual peaks are formed by the irregularity of the reefs outer edge… there are fingers of rocks that extend a little further out than the other areas…each one of those fingers forms one of the surf peaks.

The reef itself sits on a bit of a sea-shelf which acts as a buffer for some of the stronger wave energy. Essentially this shelf starts the shoaling process much further out to sea than where the waves actually break…as the waves start to feel the sea floor they begin to lose energy and eventually break with slow and soft lines as they move up the gradual sea-slope and on to the reef.

All three of the main waves at Old Man's have generally the same properties. They are slow, soft, and generally forgiving. The shoulders are on the mushy side and you almost never see the wave form any sort of a barrel except under very extreme conditions. When you get down to the nitty-gritty Old Man's is one of the best waves for beginners and casual surfers. The inside sections and whitewash are slow and steady letting first-timers and little kids get use to their boards and how the ocean is going to push them around. The outside peaks offer up a little more of a challenge (relative to the inside) with slightly steeper takeoffs and an actual wave face to work with."

Old Man's (the spot not the peak) has a relatively open swell window with good exposure to the S, SW, W and even a bit of WNW. It will work on pretty much any combination of those swells…but depending on what peak you want to surf, it really likes the medium sized SW swells (with medium to long swell-periods) and the SW/WNW combo swells.

On the pure SW swells you will get a long slow left that sets up off The Point…Old Man's and Dog Patch will have some longer left sections as well but will throw an occasional sectiony right-hander back up against the grain of the swell.

On combo swells all three peaks get peakier. The Point will still have better lefts but you will have some longer rights setting up off the Old Man's and Dog Patch peaks.

Like most of Southern California the perfect combination of wind and waves is the mix of a good SW swell, or combo swell, with light/moderate Santa Ana winds and the low-to-high tide push.

Spot Details:

***Best swell direction:** SW swell (185-220) or a SW/W combo*

***Best Wind:** NE-E, light-moderate Santa Ana winds are the best.*

***Sea Floor:** Rock reef, sand, and sea-grass*

***Best Season:** Year round…any old SW swell will do.*

***Crowds:** Yep lots of people, lots of longboards, lots of parking issues. Mostly manageable during the week…but hectic on the weekends (double so when the weather and the surf are good)."*

9.3.2. Potential Surfing Impacts

The following discussion of surfing impacts is based on a similar study done for the San Elijo Lagoon Restoration Project (Moffatt & Nichol, 2015). The parameters which affect surfing are:

- Wave exposure and/or focusing
- Wave backwash
- Type of wave break (i.e. spilling, collapsing, plunging, surging)
- Burial of reef or sand bars
- Wave breaker location

- Peel angle
- Ride length
- Wave breaking frequency
- Surfer type (e.g. beginner, advanced, shortboard, longboard)

All of these parameters generally indicate the character or condition of a surf spot. As described previously, San Onofre Surf Beach consists of three surf breaks called the Point, Old Man's, and Dog Patch. Each site is a relatively soft wave that is primarily mushing and long. As such, the entire area caters to surfers of all levels of skill (or lack thereof) and a very broad range of surfers. That is the draw of the site. Also important is the frequency of ridable surf at the site. This location can be surfed almost every day of the year, barring severe storm conditions. It is ridable when the surf is large and when the surf is small, at low tide and high tide, when the wind is blowing and when it is calm. This adds to the value of the site. The project that is proposed should be one that does not change the basic character of the surf, and maintains the daily surfing opportunity that exists there.

Three of the most applicable surfing parameters (wave exposure and/or focusing, backwash and reef burial) are considered in detail below.

Wave exposure and/or focusing will not be affected by any of the alternatives proposed. Waves can be blocked by offshore structures (breakwaters and/or reefs) or long structures extending from shore as navigation channel jetties. None of the alternatives propose such features so waves approaching shore will not be hindered or affected prior to breaking.

Backwash is commonly understood to negatively impact surfing. Backwash is frequently developed as waves reflect off a steep beach, bluff face, or seawall. Changes in backwash can also come from changes in the beach and nearshore native sediment grain size.

Each of the alternatives have varying ocean-facing / foreshore slopes. Based on the slope steepness of each of the alternatives, following is a general ranking of the alternatives based on the level of backwash, (i.e. listed from steepest to flattest) and assuming the beach is in an eroded condition (and thus the shoreline protective structure/element is exposed):

1. Alternative 2 (Narrow Footprint Armoring) **– Most Backwash**
2. Alternative 5 (Road Maintenance), Alternative 6 (Phased Retreat) and Alternative 7 (Limited Action) when a scarp face occurs along the parking area's edge or when the MHW shoreline reaches the bluff face. Either of these conditions will create a vertical or near-vertical face.
3. Alternative 1 (Rock Revetment)
4. Alternative 4 (Cobble Berm)
5. Alternative 3 (Beach Nourishment), Alternative 5 (Road Maintenance), Alternative 6 (Phased Retreat) and Alternative 7 (Limited Action) when no scarp face occurs or while the beach is undergoing natural erosion but the MHW shoreline has not yet reached the bluff face. **– Least Backwash**

As can be seen above, the time horizons associated with Alternatives 5, 6, and 7 are important factors relative to the impacts of these alternatives on surfing. In the short-term, these alternatives are only likely to create backwash if a scarp face forms along the parking area edge (as was the case in the 2017 erosion event). In the long-term, the exposed bluff face could create backwash conditions. For any of the alternatives, backwash effects can be mitigated by natural sand movement onshore or import of sand to bury the shoreline protective element.

Tides play an important part in backwash; steeper slopes tend to be higher in the beach profile and backwash during high tides can be higher than the long-term average backwash (Moffatt & Nichol, 2015). This would suggest that the alternatives with the steeper slopes would have even higher backwash at higher tides. However, it is important to note that backwash can occur even with a natural beach slope at high tide.

Direct burial of the reefs or sand bars is problematic for large volume sand nourishment placement which extends well into the surf zone. Alternatives 3, 5, 6, and 7 all have the potential for dispersing sediment into the nearshore. Alternative 3 (Beach Nourishment) would create a relatively narrow beach berm width (approximately 50-ft wide) which would not extend into the surf break location and is intended to replicate previous historical conditions (wider beaches), with natural sand dispersal into the surf zone Alternatives 5, 6, and 7 would also result in discharge of sediment into the nearshore reef as the beach and bluff erodes, which could result in temporary impacts to the surf break until the material naturally disperses. It should be noted that the location and size of sandbars naturally fluctuate seasonally and otherwise due to littoral sediment transport patterns, these fluctuations are most extreme following significant sediment discharge events from coastal rivers and streams, significant wave events, and periods of prolonged drought.

Changes in sediment grain sizes in the surf zone can cause long-term changes in backwash and other parameters. For Alternative 3 (Beach Nourishment), a primary consideration for selecting the sand source site will be sediment grain size compatibility with Surf Beach grain size and accordingly no long-term changes in backwash, etc. would be anticipated.

Adding sand to the vicinity of reef breaks (i.e. Alternative 3) has the potential to make them behave more like beach breaks, which is likely to be perceived as a negative impact to surfing. The most common surfing impact expected as a result of changing reef breaks to more beach-break-like conditions would be reduced peel angles, reduced section lengths, reduced ride times, and increased close outs, especially during larger swells. Changes in sand elevation can change the extent to which any reef behaves like a reef break, whether or not the reef is entirely covered, partially covered, or its vertical elevation contrast (relief) simply lowered relative to the surrounding sandy seafloor. Raising the sandy seafloor surrounding a reef reduces the relief between the reef and sandy seafloor. This results in less refraction shoaling at the reef and less definition to the surf site. So, any change in the sand thickness surrounding a reef could potentially change how that surf site breaks. Design (volume, beach width, etc.) and monitoring would be important elements for Alternative 3 to minimize effects to the reef break. The beach profile can be expected to differ from an unnatural shape immediately after construction of the beach nourishment to a more natural profile after a period of time; however, beach profiles built during construction are expected to be short lived, evolving to equilibrium profiles within six months after construction. It should be noted that wider beach widths existed in the past at Surf Beach.

The locations of the break point of beach breaks are expected to move seaward distances that are proportional to the amount of beach widening. For example, if the beach is widened by 50 feet, it can be expected that the beach break fronting the shoreline will move a similar distance seaward, maintaining an unchanged relative distance between the break point and the shoreline. The primary change to surfing locations at beach breaks is that they move seaward relative to geographic coordinates, but do not change perceptibly relative to the shoreline.

As was done for the San Elijo Lagoon project, monitoring should be performed to assess the implemented alternative's effects on surfing. This monitoring should include morning observations between 8am and 12 noon at least twice a week. An example of the type of data collected which should be collected is shown in the San Elijo Lagoon surf monitoring form below (Figure 9.3).

OBSERVER		**DATE**
STATION ID	**TIME (24Hr)**	**SURFER COUNT** SUP | LB | SB | BB | BS
WIND SPEED/SEASTATE (Beaufort Scale)	**BACKWASH** yes / no	
OFFSHORE 0 1 2 3 4 5 6 7 8 9 10	**PEEL DIRECTION** R L R/L	
INSHORE 0 1 2 3 4 5 6 7 8 9 10	**WIND DIRECTION IN SURF ZONE**	ONSHORE OFFSHORE CALM
	LEFTS	**RIGHTS**
WAVE HEIGHT (FT)	LOW - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+ HIGH - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+	LOW - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+ HIGH - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+
SURFABILITY	Excellent | Good to Excellent | Good | Fair to Good Fair | Poor to Fair | Poor | Ex Poor | Not Breaking	Excellent | Good to Excellent | Good | Fair to Good Fair | Poor to Fair | Poor | Ex Poor | Not Breaking
WAVE TYPE	Short / Long / Mixed | Mushy / Steep / Hollow Slow / Fast | Tight / Spread / Peaky / Shifty NoSho/ SmlSho / P-ling / Sect / Walled / Closed Weak / Punchy / Powerful Con. / Incon. / Very Incon. / Flat	Short / Long / Mixed | Mushy / Steep / Hollow Slow / Fast | Tight / Spread / Peaky / Shifty NoSho/ SmlSho / P-ling / Sect / Walled / Closed Weak / Punchy / Powerful Con. / Incon. / Very Incon. / Flat
% Unsurfable	0 / 1-20 / 21-79 / 80-99 / 100	0 / 1-20 / 21-79 / 80-99 / 100
COMMENTS:		

FIGURE 9.3: EXAMPLE SURF MONITORING FORM

9.4. PUBLIC ACCESS AND RECREATION

Public access elements which are potentially affected by the shoreline alternatives are: a) vehicular beach access to/from the bluff-top; b) vehicular parking along the beach road/parking area or elsewhere; c) public "vertical" access to and from, and "lateral" access along the sandy beach and water areas; and d) recreation on the sandy beach areas. Each of these elements is assessed in Table 9.3 for each of the alternatives.

TABLE 9.3. POTENTIAL PUBLIC ACCESS IMPACTS FOR EACH ALTERNATIVE

Alternative	Vehicular Access to Beachfront	Vehicular Parking	Access to the Sandy Beach and Water Areas	Recreation on Sandy Beach Areas
1 – Rock Revetment	No impact	No impact	During eroded conditions, beach users would have to access from non-revetted areas or cross the revetment. Access over the revetment could be maintained by burying portions of the revetment with sand, allowing beach users to walk from the parking area onto the beach. Stairways could also be constructed over the revetment.	The revetment footprint encroaches on sandy beach area and thus some recreational beach area is lost. This could be mitigated by import of sand to bury the rock or possibly natural sand accretion will occur in front of revetment. Will be eventual loss of all sandy beach area as shoreline erodes to revetment toe.
2 – Narrow Footprint Armoring	No impact	No impact	During eroded conditions, beach users would have to access from non-walled areas. Similar to Alternative 1, access over the wall could be maintained by burying the wall with sand. Stairways could also be constructed over the wall.	The wall footprint is much less than Alternative 1. Will be eventual loss of all sandy beach area as shoreline erodes to seawall.
3 – Beach Nourishment	No impact assuming beach widths maintained by regular periodic re-nourishments	No impact assuming beach widths maintained by regular periodic re-nourishments	Improved access over the existing conditions with the rock revetment and scarp beach faces.	Increased sandy beach recreational area.
4 – Cobble Berm	No impact assuming cobble berm widths maintained by regular periodic re-nourishments and/or grading	No impact assuming cobble berm widths maintained by regular periodic re-nourishments and/or grading	Walking on cobble can be difficult with bare feet, however a significant amount of cobble already exists along the beach and water areas.	Loss of sandy beach recreational area; generally, sand is preferred over cobble for lounging and recreating on the beach. Will be eventual loss of all sandy beach area as sea levels rise and shoreline erodes to cobble berm toe.

Alternative	Vehicular Access to Beachfront	Vehicular Parking	Access to the Sandy Beach and Water Areas	Recreation on Sandy Beach Areas
5 - Active Road Maintenance	No impact in near term. Will be eventual loss of access to south-end beach road due to loss of access past the pinch point.	Loss of parking spaces in near-term. Eventual loss of access to south-end parking due to loss of access past the pinch point.	No change from existing conditions. Scarp faces, which make beach access difficult, will likely continue to occur along the seaward edge of parking area, as was the case in the 2015-2016 El Niño event. Eventually, the current access to the beach and water areas will not be possible, access may only exist where the road meets the shoreline.	No change from existing conditions in near-term. Will be eventual loss of all sandy beach area as sea levels rise and shoreline erodes to bluff toe.
6 – Phased Retreat	Will be eventual loss of vehicular access to beach	Will be eventual loss of beach parking. Parking will only be available on the bluff-top	No change from existing conditions in near-term. Scarp faces, which make beach access difficult, will likely continue to occur along the seaward edge of parking area. Eventually, access to the water area will be possible only via foot travel from the bluff-top until when/if a new road is constructed (no sandy beach will exist to access as the water will be at the bluff face).	No change from existing conditions in near-term. Will be eventual loss of all sandy beach area as sea levels rise and shoreline erodes to bluff toe.
7 – Limited Action	Will be eventual loss of all access	Will be eventual loss of beach parking. Limited parking available along bluff-top roads	No change from existing conditions. Scarp faces, which make beach access difficult, will likely continue to occur along the seaward edge of parking area. Eventually, access to the water will not be possible (no sandy beach will exist as the water will be at the bluff face). Access may only exist where the road meets the shoreline.	No change from existing conditions in near-term. Will be eventual loss of all sandy beach area as sea levels rise and shoreline erodes to bluff toe.

As can be seen in this table, Alternatives 1, 2, 3 and 4 generally preserve vehicular access and public parking, whereas vehicular access and parking in the existing beachfront area would eventually be lost in Alternatives 5, 6 and 7. A caveat is that, if/when sea level rises beyond 3.3 ft, the first four alternatives may not be able to provide this beachfront public access. Public vertical access to the water and sandy beach areas is more difficult with an exposed rock revetment or vertical wall. Accommodations such as public access stairways either across the rock revetment (less challenging) or seaward of the vertical wall (more challenging) will be required for eroded beach conditions.

Alternative 1 (revetment) and Alternative 2 (vertical wall) would have a negative visual impact to the beach, especially when the beach is an eroded condition.

Steep scarp faces caused by erosion can also make water access more difficult (Alternatives 5, 6 and 7). The rock revetment and cobble berm occupy sandy beach footprint and thus will impact sandy beach recreational uses. In all alternatives except for beach nourishment, Alternative 3, the current sandy beach area will ultimately be lost to erosion and future sea level rise. Beach nourishment can be applied to any of the alternatives in order to maintain a sandy beach area for as long as is practical, (but at a cost).

It should be noted that the world-renowned surf spot Trestles is located upcoast of Surf Beach along the State Beach shoreline. This popular surfing location is only accessible via foot trail and there is no designated parking. Beach users must walk approximately 1 mile from available street parking areas to access the beach. Considering the popularity of Trestles despite these access challenges, the pedestrian-exclusive access may ultimately be suitable for Surf Beach as well.

9.5. Biological Resources

Habitat areas that will be potentially affected by any of the alternatives include: subtidal, intertidal, sandy beach, bluff face, and bluff top. The potential impacts to these biological resources are described in this section. A complete inventory of the existing biological resources on and in the vicinity of Surf Beach is provided in Appendix A.

9.5.1. Soft and Hard Bottom Subtidal

Most of the alternatives do not propose actions that may impact any subtidal habitats. The Beach Nourishment and Cobble Berm alternatives will place either sand or cobble, respectively, into the intertidal area and may include some placement in the subtidal area.

The sand placement is expected to ultimately erode and disperse further into the nearshore subtidal area and may disturb sensitive kelp or surfgrass patches that may be present. Kelp and potential surfgrass are seasonal in the area and may not be present at the time of placement. Kelp has been known to occur offshore of the upcoast half of the Surf Beach shoreline. The nearest kelp location has been shown to be located approximately 300 feet from the parking area. The dispersal of placed sand into the nearshore area is expected to occur at a rate and pattern similar to natural conditions historically experienced at this location when a wider beach was present. Potential turbidity plumes from initial sand placement would be expected to be minimal and confined to a localized area and would not reach kelp.

Motile species (e.g., fish, crabs) would be expected to temporarily leave the area when materials are placed; however, they would be expected to return once construction activities cease. Species associated with any rocky reef and/or kelp areas would not be expected to be affected by either alternative after placement.

9.5.2. Sandy and Rocky Intertidal

The introduction of new rock or cobble under the Alternatives 1 and 4 would decrease the sandy habitat for some invertebrates but may support a new, low diversity of rocky shore organisms that currently are not present on the sandy beach. In a study on coastal armoring, including rock revetments, Dugan and Hubbard (2010) has stated that coastal armoring on an open coast beach results in an initial loss of intertidal habitat through revetment placement and active and passive erosion immediately seaward of the revetment. The Beach Nourishment alternative will place sand into the intertidal area and may provide a greater mix of sandy and rocky intertidal.

The infaunal community in the general nearshore project area is dominated by a variety of motile and sessile species, including polychaete worms, mollusks, and crustaceans. Invertebrates may be disturbed or buried during rock, cobble, and/or sand placement but are anticipated to start to recover after construction activities have ceased.

Following construction, additional beach sand would be available for invertebrates to occupy under the Beach Nourishment alternative, and any hard substrate located in the intertidal zone (e.g., cobble) would be covered by the beach fill; however, the depth of cover will vary based on location and may improve diversity of available habitat. Historically, this beach has been known to support a thin veneer of sand over cobble. Conversely, under the Rock Revetment, Narrow Footprint Armoring, and Cobble Berm alternatives, rocky or hard bottom substrate is expected to be more prevalent and will allow for species to attach to these hard substrates. The Active Road Maintenance and Phased Retreat alternatives would be expected to support a mixed environment of soft and hard substrate as the beach continues to retreat toward the road and toe of the bluff.

9.5.3. Sandy Beach

Most of the alternatives do not require the active removal of any terrestrial vegetation; however, any terrestrial vegetation on the beach is expected to be lost with the Active Road Maintenance, Phased Retreat, and Limited Action alternatives. The loss of beach vegetation would occur with the gradual erosion of available beach area, and terrestrial plants seaward of the existing parking area would not be maintained. Based on the results of the reconnaissance-level biological resources survey, suitable habitat is not present on the beach to support any sensitive plant or wildlife species.

The imported sand in the Beach Nourishment alternative may erode during large wave events and be deposited in the nearshore area and throughout the Oceanside littoral cell (including adjacent beaches), although the extents of nearshore deposition will be similar to that which currently occurs seasonally (i.e., eroding beaches in the winter and sediment accretion in the summer). This alternative may affect the adjacent intertidal and subtidal habitats by either increasing the mix of sand and cobble/rocky substrate or burying some rocky habitat entirely.

Grunion are not known to occur on San Onofre State Beach; however, they are known to occur both up- and downcoast of the project area and could occur at Surf Beach if conditions support a wide, shallow-sloped, sandy beach. If construction occurs during the grunion spawning season (generally March through late August/early September) and if the high tide line occurs at or immediately seaward of the existing revetment placement area, grunion eggs may be crushed or buried with any revetment, cobble, or sand placement. In addition, after revetment or cobble placement, the resulting location of the high tide line would be expected at or on the rock revetment or highest point of the cobble berm, which initially results in the loss of sandy beach at the high tide line for grunion to spawn. Grunion would be expected to move toward the next segment of beach that provides a sandy beach at high tide.

Conversely, under the Beach Nourishment alternative, the availability of a wider beach from sand placement may provide grunion spawning habitat. If construction occurs during the grunion spawning season (generally March through late August/early September), if the high tide line occurs along the existing emergency revetment, grunion eggs may be buried by sand placement. Following construction, the high tide line would be expected to be located within sandy beach, which results in the increase of potential areas for grunion to spawn. This alternative potentially may introduce additional sand into the immediate nearshore, but this increase is expected to replicate natural conditions and is not expected to substantially affect any other fish species.

The Surf Beach area supports seabirds (e.g., gulls) and several urban-acclimated bird species (e.g., pigeon, dove, raven, crow) as well as shorebirds (e.g., willet, whimbrel) and wading birds (e.g., heron, egret). Foraging shorebirds and roosting birds, including gulls, may decrease in presence due to the decrease in available prey resources for shorebirds in the upper to mid-intertidal zone. The noise from sheet pile being driven into the ground (Alternative 2 potential design) would be expected to disturb birds in the area, including seabirds, shorebirds, and wading birds, and potentially urban-acclimated bird species. Foraging birds would be expected to avoid the area during construction activities but would return once construction activities stop. Sand placement (Alternative 3) may temporarily disrupt foraging patterns of local bird species; however, nearby foraging habitat (e.g. San Juan Creek) would not be affected. Birds would be expected to utilize more suitable foraging habitats following construction and the re-establishment of invertebrates in the intertidal zone. Alternative 3 would contribute to the increase of abundance, shelter, forage and/or rest areas for sensitive species that depend on the upper intertidal zones of sandy beaches, including wintering snowy plovers that are known to forage at San Onofre State Beach. Based on timing of construction, noise levels caused by heavy machinery use may impact the quality of foraging and nesting for a variety of birds within the immediate vicinity of the noise source if construction were to occur during bird breeding season (generally February 15 –September 15).

With the Active Road Maintenance, Phased Retreat, and Limited Action alternatives, as erosion gradually removes the parking area and existing access road, the existing structural facilities (e.g., showers, picnic tables, restrooms) will need to be removed before erosion reaches the structure while the existing access road is intact for transport, causing a temporary increase in noise to wildlife in the area when construction equipment is present.

9.5.4. Bluff Face

Most of the alternatives do not require the active removal of any terrestrial vegetation from the bluff face; however, terrestrial vegetation on the bluff face is expected to be lost with the Active Road Maintenance, Phased Retreat, and Limited Action alternatives. The loss of vegetation would occur with the gradual erosion of available beach area and parking area and ultimately would result in the waves washing up onto the vegetation at the toe of the bluff.

Although several of the plant species may be salt tolerant, these species are not expected to survive constant exposure and/or inundation by seawater or the mechanical action of the waves hitting against the individual plants. Any plants with a root system located at or below the resulting wave runup elevation would be expected to be lost. Additional plants may be lost based on location with respect to wave action.

Based on the results of the reconnaissance level biological resources survey, suitable habitat is present on the bluff to support several sensitive plant and wildlife species, including California box-thorn and California coastal gnatcatcher, both of which were identified as present at the Project site during the survey. In addition, coastal bluff scrub habitat is recognized by the California Department of Fish and Wildlife as a rare plant community.

In addition to the loss of vegetation from the toe of the bluff from the initial phase of managed retreat, additional coastal bluff vegetation would be removed to install the new foot trail, staircase, and/or access road in the subsequent phases of the Managed Retreat alternative. The amount and type of vegetation lost would be dependent on the type and location of these access paths and whether only one option of either the pedestrian access foot trail, staircase, and/or road are implemented or if all three are implemented. Vegetation does not occur on the entire bluff face and the highest density of vegetation occurs towards the base of the bluffs. The staircase option would be expected to have the smallest footprint of impact to vegetation. The foot trail would be expected to require a switchback pattern in order to safely provide access down the steep slope of the bluff.

The structure of the new access road may have an effect on the level of impact to biological resources on the bluff, depending on whether the road is cut into the side of the bluff or if a structure is built to support the new road alongside the bluff. Regardless of method, the new road would be expected to result in the greatest loss of bluff vegetation of the three access path options. In the case of cutting into the side of the bluff face, the new road would require the removal of all vegetation along the entire footprint of the new road as well as vegetation immediately adjacent to either side of the road due to new disturbance from vehicle traffic and maintenance activities for proper clearance for vehicles for safety purposes. With the adjacent road structure option, existing vegetation may be shaded by the new structure and be lost; however, the new structure may provide new nesting habitat opportunities.

In addition to the direct and indirect effects to vegetation, the wildlife associated with the vegetation would be indirectly affected by the Active Road Maintenance, Phased Retreat, and Limited Action alternatives through loss of habitat, shelter, and food source on the bluff face with a decrease in insects and other small prey that inhabit the existing coastal bluff vegetation.

9.5.5. Bluff Top

Most of the alternatives will not result in any direct impacts to the bluff top from construction activities; however, terrestrial vegetation may be indirectly affected by the Limited Action alternative over time and Phased Retreat alternative with subsequent phases, depending on location of the proposed foot trail or staircase entrance in relation to existing foot trails on the bluff top. The Limited Action and Phased Retreat alternatives do not actively manage the loss of bluff top vegetation through retreat of the shoreline and bluff.

Based on shoreline modeling of 3.3 feet of SLR, the landward edge of the shoreline position and winter erosion under the Limited Action alternative encroaches on the seaward edge of the existing bluff top vegetation. The existing paved road to the east and northeast and parking lot to the east and southeast limit vernal pool habitat on the bluff top to the existing area. With the modeled shift in position of the bluff edge, vernal pools located at the seaward edge of the existing footpath may start to erode with the coastal bluff; vernal pool habitat would decrease as the bluff retreat continues.

9.6. Permitting Considerations

All alternatives will require a Coastal Development Permit from the California Coastal Commission (CCC), except for possibly Alternative 7 (Limited Action), as the footprints of these alternatives are within the CCC’s California Coastal Zone jurisdiction.

All alternatives will require U.S. Army Corps of Engineers (USACE) and San Diego Regional Water Quality Control Board (RWQCB) permits. Alternative 5 (Active Road Maintenance), Alternative 6 (Phased Retreat) and Alternative 7 (Limited Action) will need USACE and RWQCB permits for only the removal of the existing revetment.

The California State Lands Commission (CSLC) has jurisdiction for submerged lands below the Mean High Water line; accordingly, it is likely that a CSLC lease/approval will be needed for only Alternative 3 (Beach Nourishment), Alternative 4 (Cobble Berm) and possibly Alternative 1 (Rock

Revetment); it is not likely that the CSLC will assert jurisdiction for the removal of the existing revetment done under the other four alternatives.

For Alternative 3 (Beach Nourishment), there will be additional regulatory approvals required for removal of the sand at the source site. The source material will require sampling and physical and chemistry testing for sediment placement compatibility along Surf Beach; the sampling plan and results will require regulatory approval through the Southern California Dredged Material Management Team.

Approvals will also be required from the land owner, the USMC, for any of the alternatives.

It is recommended that permits authorize application of any of the management alternative for the entire Surf Beach area, even though the alternatives can be constructed in phases determined by site-specific triggers like beach width or facility damage. A plan should be implemented to establish baseline conditions and monitor future shoreline changes. The permits should allow for long-term maintenance actions like repeated beach nourishment or revetment repair.

All alternatives will require review under the California Environmental Quality Act (CEQA). It is likely that Alternative 5 (Active Road Maintenance) and Alternative 7 (Limited Action) would be classified Categorically Exempt under CEQA. The other five alternatives are likely to have significant but mitigatable impacts and thus would require a Mitigated Negative Declaration type of CEQA document.

9.7. Preliminary Construction and Long-Term Maintenance Costs

Table 9.4 below summarizes the costs for each of the alternatives. Note: the total costs shown are assuming implementation of the alternative along the entire shoreline segment which may ultimately not be the case. As shown in the table, the actual cost of installing the 800-LF emergency rock revetment was $1.3M; this spent cost is included in the total cost for Alternative 1, but is also a sunk cost relative to implementation of any of the alternatives. As can be seen in Table 9.4, the ranking of the alternatives, from least to most cost over a 50-year timeframe, is:

1. Limited Action (Least Cost)
2. Active Road Maintenance
3. Rock Revetment
4. Cobble Berm
5. Phased Retreat
6. Narrow Footprint Armoring
7. Beach Nourishment (Most Cost)

Although the beach nourishment alternative is the most expensive alternative, its economic value is likely the highest, i.e. the long-term economic value may outweigh the construction cost.

It should also be noted that there would be additional costs for engineering design, environmental review, permitting, construction management, etc. for any of the alternatives; these “soft” costs are not included in the costs shown in Table 9.4. The ranges of costs are presented graphically in Figure 9.4 and Figure 9.5.

TABLE 9.4: OPINIONS OF PROBABLE CONSTRUCTION COSTS (PRELIMINARY) BASED ON CONCEPTUAL DESIGNS

	Alternative	Phase 1 Range of Costs		Phase 2 Range of Costs		Phase 3 / Maintenance Range of Costs		# of Maintenance Events Assumed in Total (beyond Phases 1 and 2)	Range of Total Costs Over 50-Year Period	
1	Rock Revetment with Two Stairways	$1,300,000		$3,080,000	$4,980,000	$300,000	$500,000	3	**$5,280,000**	**$7,780,000**
2	Narrow Footprint Armoring with Two Stairways	$4,100,000	$9,000,000	$8,300,000	$18,000,000	$200,000	$400,000	2	**$12,800,000**	**$27,800,000**
3a	Beach Nourishment with Offshore or Harbor Source	$2,600,000	$5,600,000	$3,300,000	$7,100,000	$5,900,000	$12,700,000	5	**$35,400,000**	**$76,200,000**
3b	Beach Nourishment with Upland Source	$1,300,000	$2,900,000	$3,000,000	$6,500,000	$4,300,000	$9,400,000	5	**$25,800,000**	**$56,400,000**
4	Cobble Berm	$2,400,000	$5,100,000	$3,800,000	$8,100,000	$400,000	$800,000	5	**$8,200,000**	**$17,200,000**
5	Active Road Maintenance	$1,500,000	$2,300,000	$460,000	$750,000	$60,000	$90,000	30	**$3,760,000**	**$5,750,000**
6	Phased Retreat	$900,000	$1,400,000	$3,700,000	$8,000,000	$5,100,000	$11,000,000	0	**$9,700,000**	**$20,400,000**
7	Limited Action	$900,000	$1,400,000	$70,000	$120,000	$0	$0	0	**$970,000**	**$1,520,000**

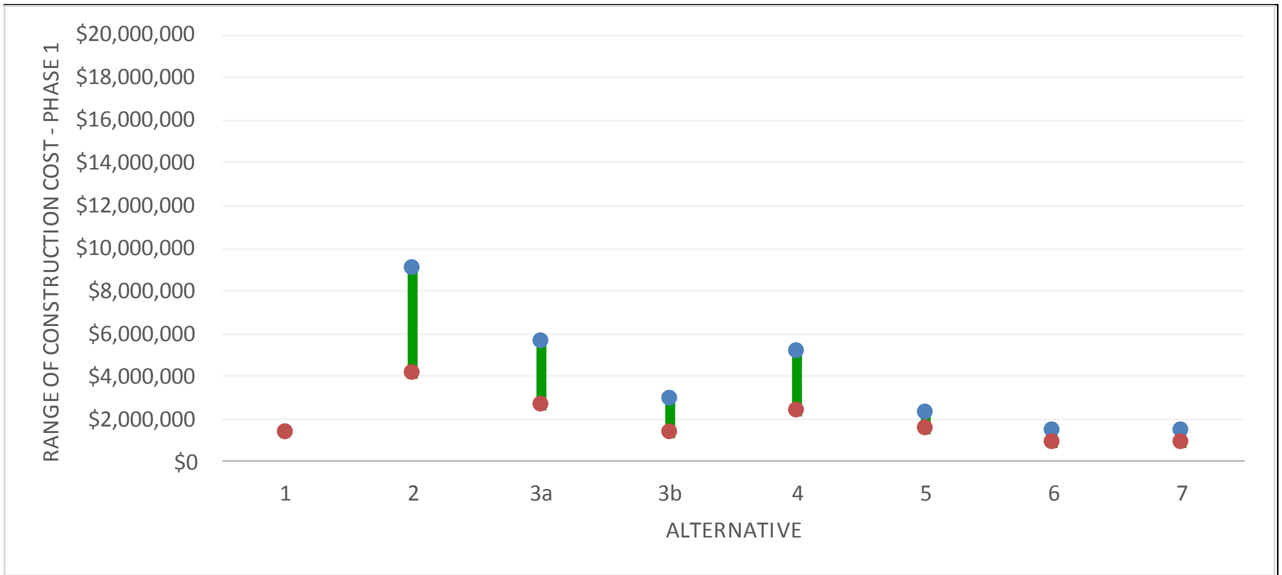

FIGURE 9.4: PHASE 1 ESTIMATED CONSTRUCTION COST FOR EACH ALTERNATIVE

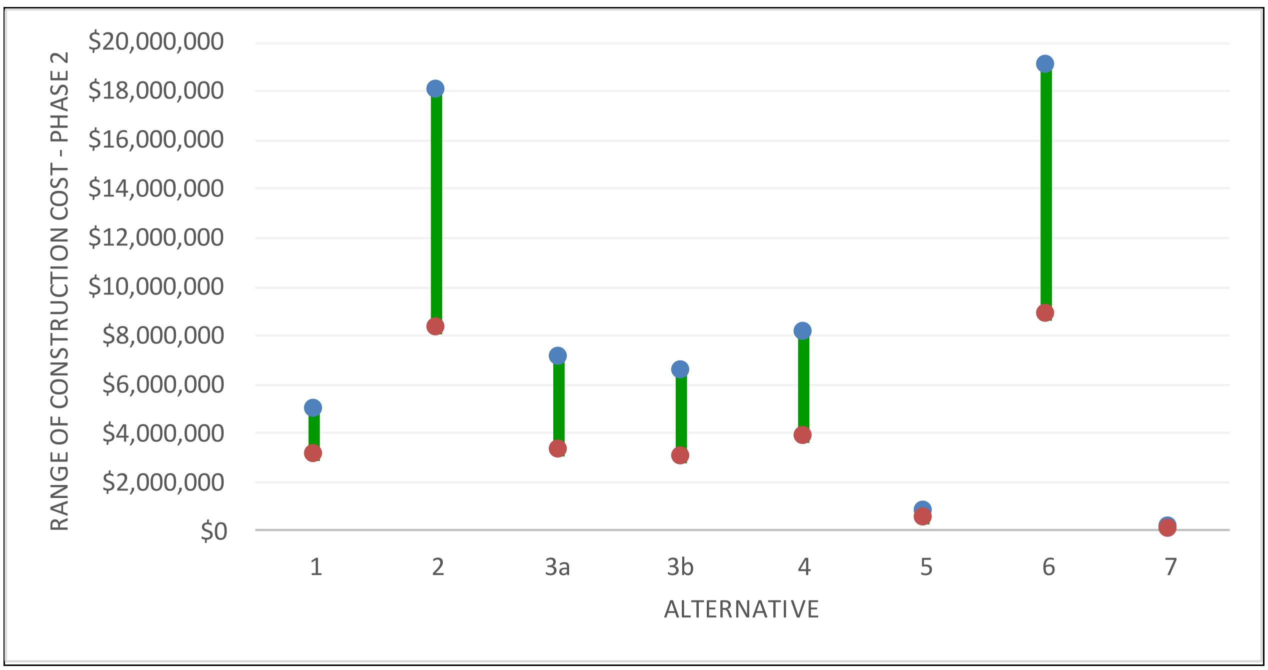

FIGURE 9.5: PHASES 2/3 ESTIMATED CONSTRUCTION COST FOR EACH ALTERNATIVE (NOT INCLUDING MAINTENANCE COSTS)

10. SUMMARY

The following can be concluded for the San Onofre Surf Beach study area:

- The surf zone / nearshore area is relatively shallow with large amounts of naturally-occurring cobble; these conditions provide for a popular and historically-consistent surf spot.
- Aerial photographs and data show that the beach was generally wide from the late 1960s to the 1980s, which was likely a result of sand placement from construction of the adjacent SONGS facility and large natural sediment inputs from upcoast creeks/streams during several El Niño heavy rain events.
- Historically, anthropogenic beach nourishment events provided equal (or more) sediment inputs to the Oceanside Littoral Cell than natural creek/stream sediment discharges; these nourishments helped to maintain all beaches within the Oceanside Cell.
- Under current conditions (no SLR), analyses show that the annual (1-year) wave run-up reaches elevations of +20 ft NAVD88 at “The Point” with no revetment in place; this level of run-up floods and erodes the road/parking area which is at an elevation of +15 to +18 ft NAVD88. Thus, under current (narrow) beach width conditions, “The Point” road and parking areas will likely be flooded and need to be repaired <u>annually</u> without a revetment in place.
- In other locations along Surf Beach, the FEMA base flood elevation (BFE) based on a statistical 100-year (1% annual chance) wave event is +20 to +22 ft NAVD88, as compared to the existing road/parking area elevation of +15 to +18 ft NAVD88. The FEMA BFE does not consider future sea level rise or erosion. FEMA analyses predict that even the 10-year (10% annual chance) event would flood the road and parking area all the way to the bluff.
- With +0.8-ft of SLR (2030 to 2040 time horizon based on OPC 2018), the CoSMoS model projects that the road at the “pinch point” at the northern end of Surf Beach will lose approximately half of its width and the mean high water (MHW) line will be at the seaward edge of the parking area, or further landward, along most of the remaining Surf Beach shoreline.
- With +1.6-ft of SLR (2050 to 2080 time horizon based on OPC 2018), the CoSMoS model projects that the road at the “pinch point” will not exist (i.e. the shoreline will be at the toe of the bluff) and the MHW line will be well into the parking area along most of the Surf Beach shoreline.
- Under the +3.3-ft scenario (2070 to 2130 time horizon), the CoSMoS model projects a shoreline position well into and beyond the current bluff face, i.e. the beach parking and road will not exist.
- A trade-off exists between ocean-front parking and immediate beach access versus more difficult longer walks to the water but with a natural retreat process.
- Shoreline management decisions will require approval from the USMC Camp Pendleton as they hold the fee-title for both Surf Beach and the SONGS bluff-top parking lot (potential long-term parking solution for Surf Beach visitors).

This report identifies and analyzes a range of shoreline management strategies for maintaining public access and recreation opportunities at Surf Beach. Table 10.1 provides a summary of the seven potential shoreline management alternatives/methods.

TABLE 10.1: COMPARISON OF SELECTED SHORELINE MANAGEMENT ALTERNATIVES

Criteria	Alternative 1 – Rock Revetment	Alternative 2 – Narrow Footprint Armoring	Alternative 3 – Beach Nourishment	Alternative 4 – Cobble Berm	Alternative 5 – Active Road Maintenance	Alternative 6 – Phased Retreat	Alternative 7 – Limited Action (No Build)
Alternative Description	Retain existing rock revetment. Add additional revetment segments as needed. Perform beach nourishment as practical.	Remove existing rock revetment. Install vertical wall with sculpted concrete aesthetic fascia.	Retain existing revetment, with no additional revetment sections. Create wider beach by nourishment and burial of revetment with sand.	Remove existing rock revetment. Place cobble berm.	Remove existing rock revetment. Repair road as needed.	Remove existing revetment. Implement various phases of landward retreat, including a long-term potential of utilizing the SONGS bluff-top parking lot.	Remove existing revetment. Remove beach restrooms as necessary.
Key Pros	Durable protection for road and parking area. Maintains existing beachfront public parking and roadway.	Durable protection for road and parking area. Narrower footprint.	Increases useable recreational sandy beach area. High economic value Direct antidote to sea level rise Maintains existing access. Impacts, if any, are <u>not</u> permanent, i.e. impacts are mitigated as sand is naturally transported away from site over time.	Mimics natural conditions at Surf Beach, (although cobble previously buried in intertidal and dry beach areas). Maintains existing access.	Reactionary response is proportional to damage. Limited change from existing State Beach maintenance activities	Allows for natural retreat of shoreline	Allows for natural retreat of shoreline
Key Cons	Reduced sandy beach area. Increased wave reflection when revetment exposed (potential impact to surf).	Can exacerbate local and downcoast erosion. Increased wave reflection when wall is exposed (potential impact to surf).	Effective lifespan is dependent on magnitude and frequency of storms. Long-term maintenance required; significant long-term maintenance costs.	Cobble is more permanent than sand. Introducing large amounts of cobble has potentially unforeseen and irreversible impacts. Cobble is a less accessible substrate to walk and sit/lie on; beach users generally prefer sand to cobble.	Even 1-year-return storm could result in substantial damages. Potential for steep scarp face(s) as beach erodes	Requires coordination with SONGS and approval from USMC for use of bluff-top areas. Less convenient beach access in the long-term. Reduced/eliminated beachfront vehicular parking and access.	Eventual loss of beach access and State Park facilities. Loss of emergency service access.
Coastal Hazards	Prevents loss of the road, parking area and other facilities caused by continuing shoreline erosion.	Prevents loss of the road, parking area and other facilities caused by continuing shoreline erosion.	Minimizes potential loss of the road, parking area and other facilities caused by continuing shoreline erosion, assuming beach width is maintained.	Minimizes potential loss of the road and parking area caused by continuing shoreline erosion, assuming cobble berm width is maintained.	Does not protect facilities against coastal hazards, similar to historic maintenance. Provides some adaptation.	Does not protect existing facilities against coastal hazards, but provides adaptation plan for relocating them.	Does not provide protection against coastal hazards.
Public Access & Recreation, including Surfing	Access to/from the beach across the revetment section is difficult, but could be mitigated by construction of stairways. Revetment encroaches on recreational beach area.	Wave reflection / backwash during eroded conditions will adversely affect surfing. Access to/from the beach across the wall section is difficult, but could be mitigated by construction of stairways. Smaller beach footprint than revetment.	Sand provides additional recreational area and can maintain quality of surf breaks if done properly.	Cobble may not be liked by beach users. Unknown effects on surfing if imported (additional) cobble migrates into nearshore.	Loss of beachfront parking and access in the medium- to long-term. Loss of sandy beach area as shoreline erodes	Loss of beachfront parking in the medium- to long-term. Loss of sandy beach area as shoreline erodes	Loss of beachfront parking in the short- to medium-term. Loss of sandy beach area as shoreline erodes

Criteria	Alternative 1 – Rock Revetment	Alternative 2 – Narrow Footprint Armoring	Alternative 3 – Beach Nourishment	Alternative 4 – Cobble Berm	Alternative 5 – Active Road Maintenance	Alternative 6 – Phased Retreat	Alternative 7 – Limited Action (No Build)
Biological Resources	Permanent loss of sandy beach and intertidal habitat from revetment footprint, (however it should be noted that loss of sandy beach and intertidal habitat will occur without the revetment when/if the shoreline continues to erode).	Potential impact to nearshore subtidal habitat (e.g. kelp) if wave reflection causes increased erosion and sand discharges into nearshore area.	Additional sandy beach and intertidal habitat areas. Potential impact to nearshore subtidal habitat (e.g. kelp) as sand erodes off beach Temporary impact to intertidal benthic organisms by burial during initial sand placement.	Potential impact to nearshore subtidal habitat. Temporary impact to intertidal benthic organisms by burial during initial cobble placement. Loss of sandy beach organisms.	Loss of sandy beach and intertidal habitat, and eventually bluff face and bluff top habitat, will occur as the shoreline erodes over time.	Loss of sandy beach and intertidal habitat, and eventually bluff face and bluff top habitat, will occur as the shoreline erodes over time.	Loss of sandy beach and intertidal habitat, and eventually bluff face and bluff top habitat, will occur as the shoreline erodes over time.
Permitting	Permits required from USACE, RWQCB, CCC and potentially CSLC, for construction and long-term maintenance.	Permits required from USACE, RWQCB, CCC and potentially CSLC, for construction and long-term maintenance.	Permits required from USACE, RWQCB, CCC and potentially CSLC, for construction and long-term maintenance. Additional regulatory approvals for sand source site.	Permits required from USACE, RWQCB, CCC and potentially CSLC, for construction and long-term maintenance.	Permits required from USACE, RWQCB and CCC for removal of the existing revetment.	Permits required from USACE, RWQCB and CCC for removal of the existing revetment.	Permits required from USACE, RWQCB and CCC for removal of the existing revetment.
Constr. Cost Estimate ~800 LF (Phase 1)	$1.3M (spent)	$4.1M to $9.0M	$1.3M to $5.6M	$2.4M to $5.1M	$1.5M to $2.3M	$0.9M to $1.4M	$0.9M to $1.4M
Constr. Cost Estimate -2,000 LF (Phase 2)	$3.1M to $5.0M	$8.3M to $18.0M	$3.0M to $7.1M	$3.8M to $8.1M	$0.5M to $0.8M	$8.8M to $19.0M (includes Phase 3 bluff-top access)	$0.1M
Long-term Maintenance	Periodic inspection and repair of rock revetment. Repairs would entail retrieving rock that has fallen out of section and replacing it back into section, and possibly also import of additional rock.	Periodic inspection and repair of concrete fascia.	Periodic (~every 5 -10 years) sand nourishment Periodic repair of rock revetment.	Periodic need to import additional cobble.	Continual road / parking area repair, including import of road material and grading until the road is completely lost.	Existing road / parking area repair in the near-term. Inspection and maintenance of bluff wall, stairway, bluff trail, and new roadway in the long-term.	None

11. Long-Term Hazard Management Plan ("Recommendation")

Although seven separate alternatives have been developed, it is not necessary to select implementation of only one alternative path forward. Each of these alternatives (in full or in part) can be mixed and matched as various phases of one long-term plan. For example, Alternative 1 (Rock Revetment) may be implemented (retained) only along its existing extents, but this would not preclude implementation of Alternative 4 (Cobble Berm) along other shoreline segments in the future. Similarly, Alternative 3 (Beach Nourishment) could occur with implementation of any of the alternatives, at any time. This phased approach for long-term hazards management is discussed further below.

It is anticipated that appropriate shoreline management strategies may change over time, i.e. the specific approach for San Onofre Surf Beach will likely need to be adapted over time. Additionally, some of the best solutions may be cost-prohibitive in the near-term or even over the long-term. A suggested adaptive hazard management plan over the current, medium, and long-term horizons, generally based on the alternatives described previously, is:

<u>Current-term</u>

- Continue to monitor and document beach and road widths, road conditions, and risk of damage to Surf Beach facilities; a conceptual/draft monitoring plan with "trigger criteria" for additional actions is provided in Appendix G.
- Continue to monitor surfing conditions to determine if the revetment is impacting surfing.
- Retain the existing rock revetment as a short-term shoreline management solution based on the following:
    - The existing revetment section maintains access around the northern pinch point to naturally wider segments of the beach where the majority of parking area is located;
    - Local and downcoast beach widths, erosion, and surf impacts will be monitored. The existing revetment segment should only be removed if it is causing adverse effects (based on pre-determined "triggers") or if a long-term solution which provides alternate access is implemented.
    - The best surfing at The Point is the offshore area just downcoast of the existing revetment. Backwash effects from the revetment appear to have negligible effects on surfing. Even prior to the revetment, backwash was common in this area during high tides typically resulting in surfers seeking other areas. These characteristics remain and waves only encounter the revetment during high tides.
    - Ongoing surf monitoring will identify revetment issues, if any.
    - Natural beach processes may facilitate continuous or seasonal burial of the revetment.

<u>Current- to Medium-term</u>

- Continue to maintain the road as practical (Alternative 5) while allowing for retreat/loss of seaward parking spaces.

- Monitor the costs of maintenance work required following storm wave events versus park fee revenue over time.
- Pursue sand nourishment opportunities and as sand becomes available, place on the beach to bury the existing rock revetment and to provide shoreline protection for other segments of Surf Beach and/or as pilot project to monitor beach loss rates and effects, if any, on surfing.
- Explore partner opportunities for beach nourishment, e.g. SANDAG ongoing beach nourishment program, USACE San Clemente beach nourishment program, and other regional solutions to address sea level rise.
- If/when beach widths decrease along currently unprotected segments and loss of critical State Beach facilities such as the restrooms are threatened, either remove the threatened restroom(s) (Alternative 6/7), reconfigure the road/parking areas (Alternative 5), or place additional rock revetment segments (Alternative 1).

<u>Medium- to Long-term</u>

- Continue to maintain the road as practical (Alternative 5) while allowing for retreat/loss of seaward parking spaces.
- Continue to monitor the costs of maintenance work required following storm wave events versus park fee revenue over time.
- When/if funding and sand sources become available, provide beach nourishment in conjunction with the rock revetment (Alternative 1).
- If funding and sand sources are not available to be able to maintain a recreational beach area, implement the bluff-retaining wall element (Phase 2A) of the Phased Retreat Alternative 6 to allow for continued public access around the pinch point.
- Assess the monitoring results from the Cardiff Beach cobble berm / living shorelines pilot project. If Cardiff application is successful, implement a cobble berm (Alternative 4) as a smaller scale pilot project at the far south end of Surf Beach; adapt the design based on the Cardiff Beach results. Monitor the cobble berm effects, if any, along the San Onofre State Beach shoreline. Larger scale import of cobble is not recommended unless it is clear that the additional cobble will not affect surfing conditions; unlike sand, the cobble will likely not disperse over time and thus any cobble impacts would be permanent.

<u>Long-term</u>

- As excessive wave overtopping and erosion occurs with sea level rise, implement phases 3A and/or 3B of phased retreat (Alternative 6), i.e. install stairway, path, and/or road from bluff-top to the beach. However, the use of the bluff-top areas will be dependent upon approval from the USMC and the SONGS decommissioning schedule.

As stated previously, a shoreline and surf monitoring program should be implemented and maintained in order to effectively document and analyze existing local and downcoast conditions, short-term changes associated with extreme storm events, and long-term shoreline changes. This monitoring data would provide the data necessary for the hazard management approach outlined above. The shoreline data collection would include: performing shoreline surveys to monitor changes after storm events; capturing extreme water elevations, wave heights, runup heights, and debris lines; and photographing shorelines, coastal structures, and sustained damage, with accompanying written observations. The surfing data collection would include the items required by the Coastal Commission for interim surf monitoring, as well as possibly observation and interviews of surfers, data forms, photographs, videos.

It is recognized that implementation of most any shoreline management alternative is likely beyond State Parks' existing budget. However, funding and partnership opportunities may be available to State Parks for Surf Beach. These potential funding sources and opportunities are:

- Opportunistic sand sources, i.e. State Parks could partner with entities with sediment removal needs to obtain the sediment for placement on Surf Beach, as opportunities arise;
- Partnerships with the U.S. Army Corps of Engineers' San Clemente beach nourishment project and/or SANDAG for offshore sand sources; cost-share dredge and sand placement construction costs;
- Partnerships with the USMC Camp Pendleton to collaborate on joint solutions for both Surf Beach and the upcoast RV campground which is also experiencing erosion problems. Anecdotal accounts indicated Camp Pendleton could be a nearby opportunistic sand source. Sand could be placed at the upcoast military beach resort or directly at Surf Beach;
- FEMA Flood Mitigation Assistance and Pre-Disaster Mitigation funding;
- State Coastal Conservancy in-lieu fee programs;
- State Coastal Conservancy Proposition 1, Explore the Coast and other grants for projects which promote and implement State plans and policies, e.g. coastal access improvements, living shorelines, and coastal restoration (additional info at www.scc.ca.gov/grants/);
- Ocean Protection Council Proposition 1 and Proposition 84 grants for projects and programs consistent with the OPC strategic plan. Proposition 84 targeted funding includes State Parks improvements, public access to natural resources, and flood control; and
- Entities with projects requiring compensatory mitigation, i.e. Surf Beach could serve as the mitigation site for projects (other entities) with impacts to coastal access, sandy beach, dune habitat, or other marine habitat which require mitigation.

It may be possible for State Parks to utilize one or more of the above options, and potentially other grant opportunities which come up in the future, to fund planning, design and construction of shoreline management methods along Surf Beach.

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APPENDIX A: EXISTING BIOLOGICAL RESOURCES AT SURF BEACH

BIOLOGICAL RECONNAISSANCE SURVEY REPORT FOR THE SAN ONOFRE STATE BEACH SHORELINE PROTECTION PROJECT SAN ONOFRE, CALIFORNIA

Prepared for:

CALIFORNIA STATE PARKS
8471 North Coast Highway
Laguna Beach, California 92651

and

MOFFATT & NICHOL
3780 Kilroy Airport Way, Suite 600
Long Beach, California 90806

Prepared by:

CHAMBERS GROUP, INC.
5 Hutton Centre Drive, Suite 750
Santa Ana, California 92707
(949) 261-5414

May 2018

SUMMARY OF FINDINGS

This reconnaissance-level biological resource survey was conducted for Moffatt & Nichol for the San Onofre State Beach Study Project (Project). The Project proposes to provide long-term alternatives for the California State Parks (Parks) emergency rock revetment (Project) located at San Onofre State Beach in the County of San Diego, California.

The Project site is primarily a sandy beach with adjacent parking lots backed by a coastal bluff, providing public recreation and coastline access. Within the Project site and surrounding areas are vegetation communities consisting of both native and exotic species. Although no nearshore surveys were conducted as a part of this reconnaissance survey, patches of kelp are expected to occur within or near the Survey Area. Marine invertebrates, fish, cetaceans, and pinnipeds also are known to occur within or near the nearshore Survey Area.

The Survey Area for the field survey included the approximate 900 linear feet of revetment, adjacent extent of the state beach, nearshore, and adjacent coastal bluff. A total of 105 terrestrial plant species were observed or otherwise detected during this survey. Based on literature review results analyzed for this Project, 29 sensitive plants, 1 of which is federally and/or state listed as endangered or threatened, have a potential to occur in the vicinity of the Project site. Two sensitive plant species were detected during the survey. A total of 20 wildlife species were observed or otherwise detected during the survey: 4 mammal species, 1 reptile species, and 15 avian species. One sensitive avian species was detected in the Survey Area.

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SECTION 1.0 – INTRODUCTION

Chambers Group was retained by Moffatt & Nichol to conduct a literature review and a reconnaissance-level biological resource survey for the San Onofre State Beach Shoreline Protection Project (Project) to document the existing biological resources, including vegetation communities, and to assess the terrestrial and nearshore habitats present for their potential to support sensitive plant and wildlife species. This Project proposes to provide long term solutions for the California State Parks 900 linear feet emergency rock revetment on a site located at Surf Beach in San Onofre State Park, California.

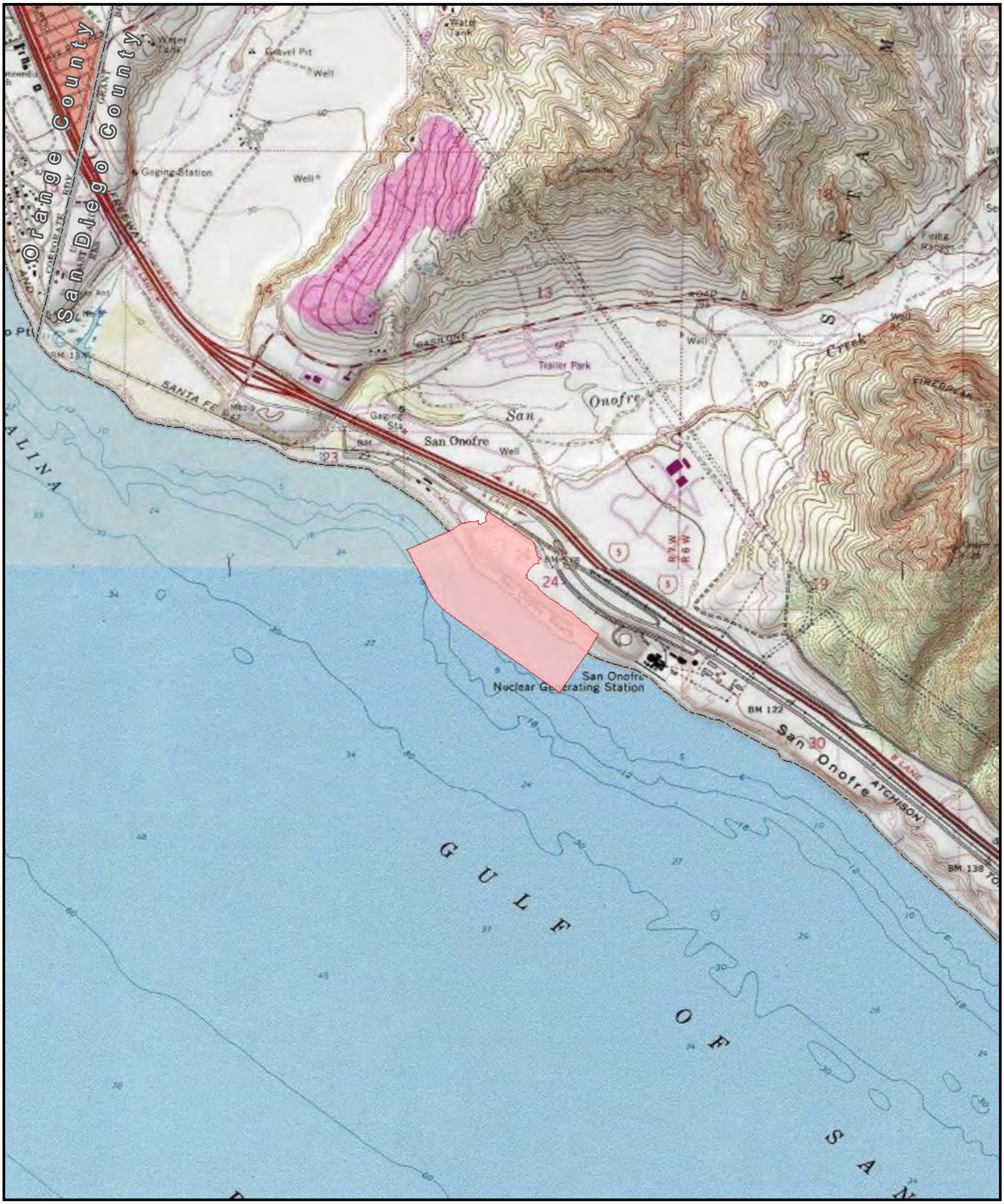
1.1 PROJECT LOCATION

The Project is located at San Onofre State Park along Surf Beach approximately two miles south of the Orange County -San Diego County border in San Diego County, California (Figure 1). It is located at the border of two U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles, *San Onofre Bluff* and *San Clemente,* in the Special Survey Section Santa Margarita Y Las Flores of Township 9S, Range 7W. The elevation of the Project site ranges from zero to 100 feet above mean sea level (amsl) and the nearshore area ranges to about -20 feet mean lower low water (MLLW).

There are residential and commercial areas further north of the Project in nearby San Clemente. Two creeks, San Mateo and San Onofre, sit just outside north of the Project area. To the immediate south is the San Onofre Nuclear Generating Station (SONGS). Just beyond the bluff is a railroad and the Interstate-5 freeway. To the east of the Interstate-5 freeway is the Marine Corps Base Camp Pendleton. Directly within the Project area is an unpaved dirt parking lot, where the entrance is located at the northeast end of the site (Figure 2).

1.2 SURVEY AREA

The Survey Area (SA) extends beyond the immediate area of the approximate 900 linear feet of revetment to consider potential areas for alternatives, and for the purposes of this report, has been divided into three distinct sub-areas: the Seaward sub-area, the Beach/Bluff Face sub-area, and the Bluff Top sub-area (Figure 1). The Seaward sub-area is located seaward of the revetment and beach. The Beach/Bluff Face sub-area contains the Project site (revetment) itself and consists of a narrow sandy beach with an adjacent parking lot and public access as well as the vegetated coastal bluff faces, including restrooms, picnic tables, and fire pits for public and recreational use. The Bluff Top sub-area is the flat expanse of vegetated land extending inland from the Beach/Bluff Face sub-area. A large portion of the Bluff Top sub-area is fenced-in as a separate habitat restoration project and was only surveyed via binoculars from outside the fence line.



Legend

Survey Area

County Boundary

N

0 0.25 0.5

Miles

Scale = 1:30,000

Figure 1
Project Vicinity

Name: 21075 BIO Fig 1 Survey Vicinity.Mxd
Print Date: 5/16/2018, Author: msimmons

CHAMBERS GROUP

Legend

- Survey Area
- Bluff Top
- Beach/Bluff Face
- Seaward Area
- San Onofre Revetment

N

0 500 1,000

Feet

Figure 2
Survey Location

Name: 21075 BIO Fig 2 Survey Location.Mxd
Print Date: 5/14/2018, Author: msimmons

CHAMBERS GROUP

SECTION 2.0 – METHODS

2.1 LITERATURE REVIEW

Prior to conducting the biological reconnaissance survey, Chambers Group biologists reviewed existing available literature for the Project site. Chambers Group conducted database searches to determine which species, both terrestrial and marine, are known to occur within the Project vicinity. The most recent records of the California Natural Diversity Database (CNDDB, California Department of Fish and Wildlife [CDFW] 2018), and the California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California (CNPSEI) were reviewed for the quadrangles containing and surrounding the Project site, which included *Dana Point, San Clemente, Canada Gobernadora, San Juan Capistrano, Margarita Peak, San Onofre Bluff, Sitton Peak, Las Pulgas Canyon,* and *Oceanside,* California USGS 7.5-minute quadrangles. These databases contain records of reported occurrences of federally and state listed endangered or threatened or proposed endangered or threatened species, California Species of Special Concern (SSC), and otherwise sensitive species or habitats that may occur within or in the immediate vicinity of the Project site. A list of sensitive plant and wildlife species potentially occurring within the Project site was developed from the database searches and the potential for occurrence of sensitive plant and wildlife species, including species listed as threatened or endangered, and sensitive habitats was assessed.

2.1.1 Soils

Prior to conducting the surveys, soil maps referenced online from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey (USDA 2018) were reviewed for soil types found within the Project footprint area for the San Onofre State Beach area of Orange County.

2.2 RECONNAISSANCE-LEVEL FIELD SURVEY

A reconnaissance-level field survey was conducted and biological resources on the Project site and within the SA were inventoried. Qualitative observations were made of habitat types on site, including soil and vegetation types. Notes were made on general vegetation types, sensitive habitats existing within the SA, and both plant and wildlife species observed. No field surveys were conducted in the nearshore area.

2.2.1 Vegetation

Vegetation communities within the SA were identified and qualitatively described. Plant communities were determined in accordance with the categories set forth in Sawyer et al. (2009), Holland (1986), or Gray and Bramlet (1992). Plant nomenclature follows The Jepson Manual: Second Edition (Baldwin et al. 2012). A list of plant species observed during the survey is included as Appendix A.

2.2.2 Wildlife

The distribution and relative abundance of wildlife, wildlife resources, and wildlife habitats within the SA were characterized. Wildlife and wildlife sign (including any tracks, scat, carcasses, burrows, nests, excavations, and vocalizations) were noted and recorded. A list of wildlife species observed during the survey is included as Appendix B.

2.2.3 Sensitive Species

The potential for occurrence of special status plants and wildlife was evaluated through a literature review and field survey. Sensitive plant and animal species include all federally and state listed endangered and threatened species. A sensitive species was considered a potential inhabitant of the Project site if general habitat requirements of the species were present (such as the presence of roosting, nesting, or foraging habitat or a permanent water source) and/or its known geographical distribution encompassed or was immediately adjacent to part of the Project site. All terrestrial habitat types on the site were surveyed using binoculars or were visited on foot, and the probability for special status plants to occur on site was evaluated. Nearshore habitats were evaluated for sensitive species based on the literature review.

Factors used to determine the potential for occurrence included the quality of habitat, elevation, and the results of reconnaissance survey. In addition, the location of prior CNDDB records of occurrence was used as additional data; but because the CNDDB is a positive-sighting database, these data were used only in support of the analysis from the previously identified factors. The "potential for occurrence" ranking is based on the criteria in Table 1.

Table 1: Criteria for Evaluating Sensitive Species Potential for Occurrence

PFO*	CRITERIA
Absent:	Species was not observed during focused surveys conducted at an appropriate time for identification of the species or species is restricted to habitats that do not occur on the Project site, or suitable habitat conditions are not present on site.
Low:	Habitats needed to support the species are of poor quality within the Project site.
Moderate:	Either habitat requirements or environmental conditions associated with the species occur within the Project site; or marginal habitat exists within the site and a historical record exists of the species within the Project site or immediate vicinity of the Project site.
High:	Both the habitat requirements and environmental conditions associated with the species occur within the site and a historical record exists of the species within the Project site or its immediate vicinity.
Present:	Species was observed within the Project site at the time of the survey.

Note: *PFO: Potential for Occurrence

Location information on some sensitive species is not available; therefore, for survey purposes, landscape factors associated with species occurrence requirements may be considered sufficient to give a species a positive potential for occurrence.

The following list of abbreviations was used in the identification of biologically sensitive resources potentially occurring within the Project site.

Federal

FE = Federally listed; Endangered
FT = Federally listed; Threatened
FC = Federal Candidate for listing

State

ST	=	State listed; Threatened
SE	=	State listed; Endangered
RARE	=	State-listed; Rare (Listed "Rare" animals have been redesignated as Threatened, but Rare plants have retained the Rare designation.)
SSC	=	State Species of Special Concern
WL	=	CDFW Watch List

CNPS California Rare Plant Rank (CRPR)

1A	=	Plants presumed extinct in California
1B	=	Plants rare and endangered in California and throughout their range
2	=	Plants rare, threatened, or endangered in California, but more common elsewhere in their range
3	=	Plants about which we need more information; a review list
4	=	Plants of limited distribution; a watch list

CRPR Extensions

0.1	=	Seriously endangered in California (greater than 80 percent of occurrences threatened/high degree and immediacy of threat)
0.2	=	Fairly endangered in California (20-80 percent occurrences threatened)
0.3	=	Not very endangered in California (less than 20 percent of occurrences threatened)

SECTION 3.0 – RESULTS

The reconnaissance survey was conducted on March 19, 2018, by Chambers Group biologists Heather Clayton and Jeremy Smith between the hours of 1030 and 1440, starting at approximately 5.0 feet MLLW, falling to a low tide of approximately 2.0 feet MLLW at time at time of completion. Weather conditions during the survey included temperatures ranging from 63 to 67 degrees Fahrenheit, wind speeds of up to 6 miles per hour, 10 to 30 percent cloud cover, and zero precipitation. A list of plant and wildlife species that were observed during the survey is presented in Appendices A and B, respectively. Representative photographs of the Project site were taken to document existing conditions (Appendix C).

3.1 SOILS

Review of USDA Soil Conservation Service and referencing the USDA NRCS Web Soil Survey (USDA 2018) determined that the Project site is located within the San Diego County Area (CA638). Based on the results of the database search, a total of four soil series mapped by USDA NRCS (1973) occur in the Survey Area: Carlsbad, beaches, Diablo, and Salinas series.

- Carlsbad gravelly loamy sand, 2 to 5 percent slopes: Carlsbad series consists of shallow to moderately deep, moderately well drained soils that form in marine terraces that almost parallel the coast. Carlsbad soil series are gently sloping to moderate steep and are found at elevations from 30 to 300 feet.

- Coastal beaches occur as gravelly and sandy beaches along the Pacific Ocean, where the shore is washed and rewashed by ocean waves. Part of this land type is likely to be covered with water during tide fluctuations and stormy periods. It supports no vegetation.

- Diablo clay, 30 to 50 percent slopes: Diablo series consists of well drained soils that formed in residuum weathered from shale, sandstone, and consolidated sediments with minor areas of tuffaceous material. Diablo soils are found on complex undulating, rolling to steep uplands with slopes of 5 to 50 percent, at elevations from 25 to 3,000 feet.

- Salinas clay, 2 to 5 percent slopes: Salinas series consists of well drained soils found on alluvial plains, fans, and terraces. These soils formed in mixed alluvium mostly from sandstone and shale at elevations from 50 to 2,000 feet.

3.2 NEARSHORE HABITATS

The Seaward sub-area of the SA includes the nearshore habitat and is at approximately -6 meters at the furthest extent of the SA. The project area is part of the Oceanside Littoral Cell. Similar to the adjacent beach at the San Onofre Nuclear Generating Station (SONGS), the four main marine ecological communities within the area are the sandy beach, rocky intertidal, subtidal soft bottom, and the subtidal hard bottom communities. The nearshore area of the Survey Area consists primarily of patches of surfgrass, kelp, and other algae. The SONGS artificial Wheeler North Reef is approximately three miles northeast of the Project offshore.

3.2.1 Intertidal Zone

The intertidal zone is primarily a mixture of cobble and sand, consisting of a coarse-sand intertidal beach that grades into large gravel and cobble at the lower edges. Green algae, Ulva spp., Chaetomorpha spp., and Enteromorpha spp. typically were found to colonize the upper-intertidal or splash zone in Oceanside (SAIC 2011, SANDAG 2011). Mid- to low-intertidal zones are typically dominated by red algae, such as Corallina spp. Surfgrass (Phyllospadix torryei) is a flowering plant that ranges from the intertidal to –20 feet (–6 m) MLLW and may be expected in the Project area. Surfgrass beds are considered sensitive habitats because they serve as nursery areas and shelter for many fish and invertebrate species.

3.2.2 Subtidal Zone

Low-relief bedrock and cobble-boulder substrate in the Project subtidal area supports understory algae and kelp beds (SAIC 2011, Enercon 2014). Sandy subtidal bottom habitats generally have few macrophytes because there are few areas to provide secure attachment. Algae and seagrass in the shallow sub-tidal zone within and near the Survey Area consists of mainly surfgrass and kelp, including southern palm (*Eisenia arborea*), giant (*Macrocystis pyrifera*), and feather boa kelp (*Egregia menziesii*) (CSLC 2005, Enercon 2014). Based on the Status of the Kelp Beds report, kelp beds between SONGS and San Mateo Point have been present since 1911, with 2003 to 2016 coverage ranging from 0.043 km^2 to 0.767 km^2, where areal estimates were derived from infrared aerial photographs and/or focused vessel surveys (MBC 2017). Kelp coverage in the area was shown to be dependent on season, with high recruitment in late Spring/early Summer, greatest coverage in the late Fall/early Winter before storms, and diminished canopy cover in mid to late Summer and late Winter following the storm season. Surveys in 2012 recorded a large coverage of kelp in the Survey Area (Appendix D); however, kelp was sparse to below average in 2016. Figure 3 provides the location of kelp recorded in 2016 in the project area (CDFW 2018).

3.3 TERRESTRIAL VEGETATION COMMUNITIES

The Project site itself lies within the Beach/Bluff Face sub-area of the SA and is primarily a sandy beach with parking lots and other developed facilities for public recreation and coastline access. Limited vegetation occurred on the beach and consisted primarily of non-native and ornamental landscaping with some small areas of native vegetation. The majority of the native vegetation observed within the SA consisted of Southern Coastal Bluff Scrub and Disturbed Coastal Sage Scrub. Other vegetation communities mapped on the Project site and SA are identified in the subsections below. The National Wetland Inventory (NWI) shows a narrow Freshwater Emergent Wetland along the base of the bluff at the northwest end of the SA (Appendix D); however, a jurisdictional delineation was not conducted in the SA at the time of the reconnaissance survey. All vegetation communities identified on the Project site and SA during the survey are shown in Figure 3.

The following sections summarize the principal characteristics of the vegetation communities and locations of these communities within the SA.

3.3.1 Vegetation Communities within the Beach/Bluff Face Sub-Area

The Beach/Bluff Face sub-area consisted of five different vegetation communities and two non-vegetated areas as described below.

Developed - Areas altered by humans and display man-made structures. Developed areas found within the Project site include paved roads, parking lots, and buildings.

Giant Reed/Exotics – Primarily dominated by giant reed (*Arundo donax*); however, exotic shrubs and trees were also present at lower cover. In addition to giant reed, frequent exotic species observed on site include iceplant (*Carpobrotus* spp.), jade plant (*Crassula* spp.), and agave (*Agave* spp.). These species were mapped mainly seaward of the parking lot.

Ornamental/Mixed Native Landscaping - Areas where the vegetation is dominated by non-native horticultural plants with a few native shrub species including coastal goldenbush (*Isocoma menziesii*) and quailbush (*Atriplex lentiformis*). Typically, the species composition consists of introduced trees, shrubs, flowers, turf grass, and native shrubs. Ornamental/Mixed Native Landscaping is present within the Project site largely within the sandy beach areas seaward of the parking lot.

Quailbush Scrub - Dominated by quailbush. This community typically occupies alkaline or saline clay soils (Sawyer et al. 2009). Quailbush Scrub is present in one small patch within the Sandy Beach area seaward of the parking lot on the Project site.

Saltgrass Flats - Areas dominated by salt grass (*Distichlis spicata*) that grows in flat mats. This community occupies many areas that can be intermittently flooded (Sawyer et al. 2009). Soils can range from sandy to relatively heavy clay. Saltgrass Flats were found in multiple patches within the Project site seaward of the parking lot within the sandy areas of the beach as well as along the base of the bluff slopes landward of the parking lot.

Sandy Beach – Areas of beach sand areas that are open and unvegetated. Within some of the Sandy Beach areas, several Mexican fan palm (*Washingtonia robusta*) trees are planted around areas of public use (i.e., picnic tables and fire pits). Sandy Beach is present along the entire length of the Project site as the shoreline.

Southern Coastal Bluff Scrub - A low-growing scrub forming continuous mats or with scattered shrubs, along coastal bluffs. Often the soil is void of organic material, exposing the Capistrano Formation which consists of poorly consolidated, fossiliferous, sandy-siltstone and mudstone layers. Species present on the Project site within the Southern Coastal Bluff Scrub vegetation community include native shrubs, such as coastal deerweed (*Acmispon glaber* var. *glaber*), California sagebrush (*Artemisia californica*), quailbush, coyote brush (*Baccharis pilularis*), coast cholla (*Cylindropuntia prolifera*), California buckwheat (*Eriogonum fasciculatum* var. *fasciculatum*), California box-thorn (*Lycium californicum*), coast buckwheat (*Eriogonum parviflorum*), coastal goldenbush, laurel sumac (*Malosma laurina*), California wishbone bush (*Mirabilis laevis* var. *crassifolia*), coastal prickly pear (*Opuntia littoralis*), bladderpod (*Peritoma arborea*). Some areas within this community also included non-native species such as sea-fig (*Carpobrotus chilensis*), red-stemmed filaree (*Erodium cicutarium*), crocea iceplant (*Malephora crocea*), cheeseweed (*Malva parviflora*), crystalline iceplant (*Mesembryanthemum crystallinum*), and Russian thistle (*Salsola tragus*).

Legend

- Survey Area

Shore types

- Beaches
- Rocky Shores
- Surfgrass

Tree Location

- Monkey Puzzle Tree
- Palm Tree

Vegetation Community

- Disturbed Coastal Sage Scrub
- Giant Reed/Exotics
- Native Grassland
- Ornamental / Mixed Native Landscaping
- Quailbush Scrub
- Saltgrass Flats
- Southern Coastal Bluff Scrub
- Vernal Pool

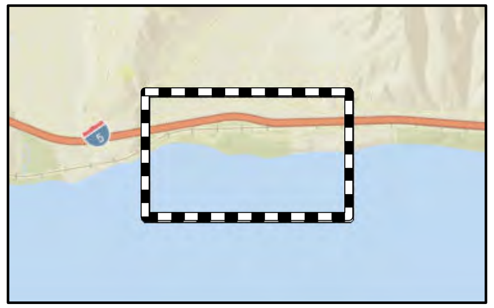


Figure 3
Vegetation Communities

Name: 21075 BIO Fig 3 VegComm.Mxd
Print Date: 5/21/2018, Author: msimmons

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Legend

- Survey Area

Shore types

- Rocky Shores
- Surfgrass

Tree Location

- Monkey Puzzle Tree
- Palm Tree

Vegetation Community

- Disturbed Coastal Sage Scrub
- Giant Reed/Exotics
- Native Grassland
- Ornamental / Mixed Native Landscaping
- Quailbush Scrub
- Saltgrass Flats
- Southern Coastal Bluff Scrub
- Vernal Pool

Figure 3

Vegetation Communities

Name: 21075 BIO Fig 3 VegComm.Mxd
Print Date: 5/21/2018, Author: msimmons

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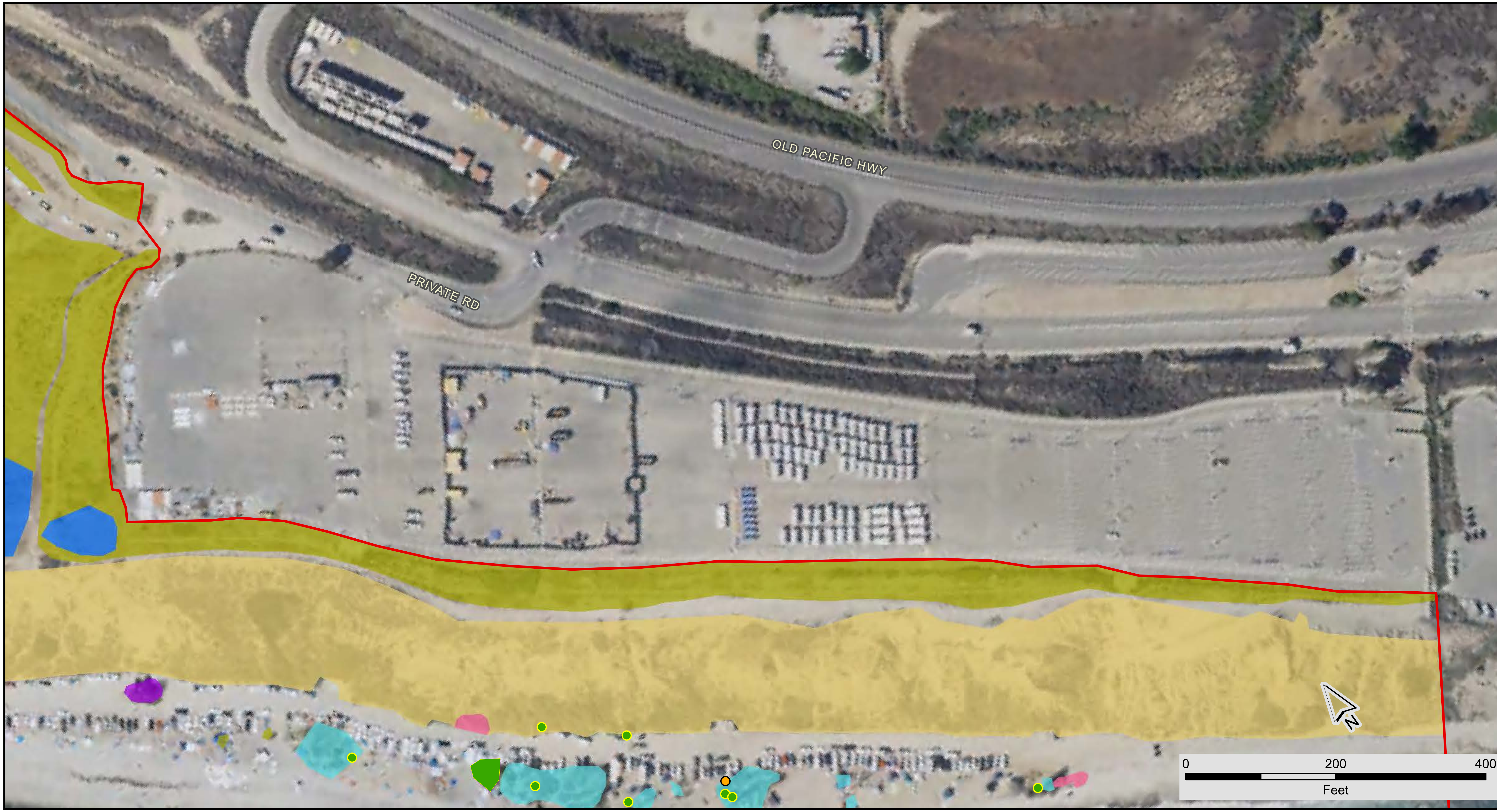

Legend

Survey Area

Tree Location

- Monkey Puzzle Tree
- Palm Tree

Vegetation Community

- Disturbed Coastal Sage Scrub
- Giant Reed/Exotics
- Native Grassland
- Ornamental / Mixed Native Landscaping
- Quailbush Scrub
- Saltgrass Flats
- Southern Coastal Bluff Scrub
- Vernal Pool

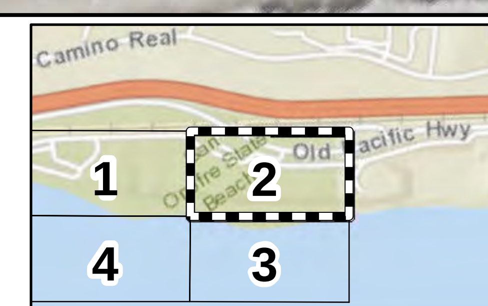

Figure 3
Vegetation Communities

Name: 21075 BIO Fig 3 VegComm.Mxd
Print Date: 5/21/2018, Author: msimmons

CHAMBERS GROUP

Legend

- Survey Area

Shore types

- Beaches
- Rocky Shores

Tree Location

- Monkey Puzzle Tree
- Palm Tree

Vegetation Community

- Disturbed Coastal Sage Scrub
- Giant Reed/Exotics
- Native Grassland
- Ornamental / Mixed Native Landscaping
- Qualibush Scrub
- Saltgrass Flats
- Southern Coastal Bluff Scrub
- Vernal Pool

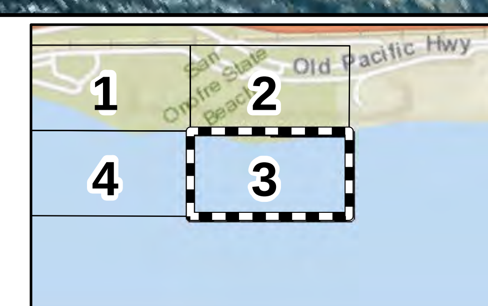

Figure 3
Vegetation Communities

Name: 21075 BIO Fig 3 VegComm.Mxd
Print Date: 5/21/2018, Author: msimmons

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Legend

Survey Area

Shore types

Rocky Shores

Surfgrass

Tree Location

Monkey Puzzle Tree

Palm Tree

Vegetation Community

Disturbed Coastal Sage Scrub

Giant Reed/Exotics

Native Grassland

Ornamental / Mixed Native Landscaping

Quailbush Scrub

Saltgrass Flats

Southern Coastal Bluff Scrub

Vernal Pool

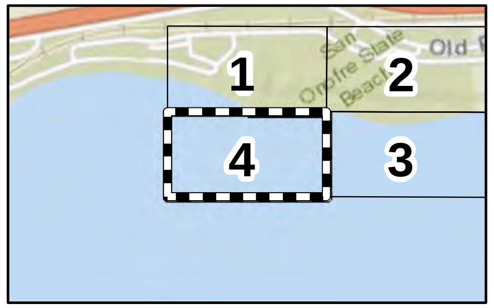

Figure 3
Vegetation Communities

Name: 21075 BIO Fig 3 VegComm.Mxd
Print Date: 5/21/2018, Author: msimmons

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3.3.2 Vegetation Communities within the Bluff Top Sub-Area

The Bluff Top sub-area has an area identified as Critical Habitat for San Diego fairy shrimp (Appendix D) and consisted of three different vegetation communities as described below.

Disturbed Coastal Sage Scrub – An intermittent to continuous, two-tiered native scrub dominated equally by California sagebrush, California buckwheat in the first tier, and larger shrubs such as laurel sumac and lemonadeberry (*Rhus integrifolia*) within the second tier. The canopy as a whole is also fragmented by 25 percent of more cover of non-native species. Dominant plant species observed within the Project site included native California sagebrush, coyote brush, California buckwheat, coastal goldenbush, laurel sumac, bladderpod, lemonadeberry, black sage (*Salvia mellifera*), and blue elderberry (*Sambucus nigra* subsp. *caerulea*). Non-native ripgut grass (*Bromus diandrus*), (red brome (*Bromus madritensis*), tocalote (*Centaurea melitensis*), poison hemlock (*Conium maculatum*), fennel (*Foeniculum vulgare*), and shortpod mustard (*Hirschfeldia incana*) were also observed within the SA associated with this community.

The Disturbed Coastal Sage Scrub within the fenced-in Vernal Pool Restoration Area maintained by the Marine Corps Base Camp Pendleton is an active habitat restoration site containing multiple vernal pools. The native shrub cover here is lower than in other areas of the Bluff Top sub-area containing Disturbed Coastal Sage Scrub.

Native Grassland – Areas where purple needlegrass (*Stipa pulchra*) and coast range melic (*Melica imperfecta*) are present in an open herbaceous layer and an understory to scattered emergent shrubs such as California sagebrush, California buckwheat, and blue elderberry which are present in low cover. Areas between native grasses and shrubs within this vegetation community were dominated by non-native annual forb and grass species. Other plant species observed within this vegetation community included native California sagebrush, coastal prickly pear, coastal goldenbush, blue dicks (*Dichelostemma capitatum*), blue-eyed grass (*Sisyrinchium bellum*), and non-native species including fennel, tocalote, and red brome.

Vernal Pool - San Onofre Mesa Vernal Pools are considered a sensitive habitat type. Soils in this vegetation community are finely textured and are typically surrounded by hummocks called mima mounds that may contain grassland habitat. Vernal pools are characterized by low depressions that sit above a hardpan or claypan layer and are typically flooded and saturated for several weeks to a few months in the winter and spring each year. Vernal pools can be differentiated from other seasonal wetland communities by containing at least one vernal pool indicator species (species known to only or predominantly occur within isolated seasonal wetlands). Although access was restricted in this area and species observations were made by binoculars, vernal pool plants found in this vegetation community on the Bluff Top sub-area include native Pendleton button-celery (*Eryngium pendletonense*), California loosestrife (*Lythrum californicum*), popcornflower (*Plagiobothrys* sp.), and woolly marbles (*Psilocarphus brevissimus*) as well as other native species including pineapple weed (*Amblyopappus pusillus*), quailbush, fascicled tarweed (*Deinandra fasciculata*), coastal goldenbush, coastal prickly pear. The Vernal Pool vegetation community was only found within the fenced-in restoration area.

3.3.3 Sensitive Terrestrial Plants

The CNDDB and CNPSEI literature reviews using a 9-quad query centered around each of the two quads (i.e., San Onofre Bluff, San Clemente) known to contain the project site resulted in a list of 92 sensitive plant species. Due to the location of the Project along the coast and the project site overlapping the border of two quads, the analysis of only the species within the San Onofre Bluff and San Clemente quads are considered most relevant and are provided in this report. This query yielded 34 sensitive plant species. The full list of 92 species included in the 9-quad reviews are provided in Appendix D.

Based on results of the March 2018 reconnaissance-level field survey, two sensitive plants, Pendleton button-celery and California box-thorn, are present within the SA. Through restoration and preservation efforts within the fenced-in area along the Bluff Top sub-area, Pendleton button-celery has been preserved within the Vernal Pool vegetation community. California box-thorn was observed during the field survey within the Southern Coastal Bluff Scrub vegetation type mapped within the Beach/Bluff Face sub-area. Additional sensitive plant species may occur within the Beach/Bluff Face sub-area or the Bluff Top sub-area; a protocol-level focused plant survey was not conducted and would be required to make this determination.

Eight of the 92 sensitive plant species are federal- and/or state-listed as endangered or threatened. Of the 34 species returned in the two-quad database searches, 29 species have suitable habitat within the SA on the Bluff Face and/or the Bluff Top and only 1 of these species is federal- and/or state-listed as endangered or threatened. There are no sensitive plant species with a potential to occur on the Sandy Beach sub-area.

Five of the 34 species are considered absent from all three sub-areas due to lack of suitable habitat or because they have never been documented within Orange County. These species are known to occur in riparian woodlands, cismontane forests, lower montane coniferous forests, coastal salt marshes, swamps, alluvial fans, chaparral, or other habitats not found within the SA. The status classifications after each species name follow the format: Federal/State/CRPR Rank.

- San Diego sagewort (*Artemisia palmeri*): --/--/CRPR 4.2
- Peninsular spineflower (*Chorizanthe leptotheca*): --/--/CRPR 4.2
- intermediate monardella (*Monardella hypoleuca* subsp. *intermedia*): --/--/CRPR 1B.3
- Fish's milkwort (*Polygala cornuta* var. *fishiae*): --/--/CRPR 4.3
- estuary seablite (*Suaeda esteroa*): --/--/CRPR 1B.2

Of those 29 species with a potential to occur or are known to occur on or within the Bluff Face and/or the Bluff Top sub-areas, their current status and habitat requirements are summarized in Table 2. Of the 34 special status plant species evaluated, 5 are considered absent due to a lack of habitat, 2 have a **low** potential to occur, 23 species have a **moderate** potential to occur, 2 species have a **high** potential to occur, and the remaining 2 species are **present** within the SA.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Aphanisma blitoides aphanisma	--/--/ CRPR 1B.2	Annual herb. Occurs in sandy areas within coastal bluff scrub, coastal sage scrub, and coastal strands at elevations up to 1,000 feet.	**Absent.** Sandy soils present, but habitat quality poor due to anthropogenic influences; species not observed during surveys conducted when species would be conspicuous.	**Moderate.** Suitable coastal bluff scrub habitat present. No historic occurrences documented within 1 mile of the site.	**Moderate.** Suitable coastal sage scrub habitat present. No historic occurrences documented within 1 mile of the site.
Atriplex coulteri Coulter's saltbush	--/--/ CRPR 1B.2	Perennial herb. Occurs in alkaline or clay soils, coastal dunes, coastal scrub, valley grasslands, and coastal bluff scrub. Can be found at elevations less than 1,500 feet.	**Absent.** Suitable clay soils and coastal scrub habitat not present.	**Moderate.** Suitable coastal bluff scrub habitat present. No historic occurrences documented within 1 mile of the site.	**Moderate.** Suitable coastal scrub habitat present. No historic occurrences documented within 1 mile of the site.
Atriplex pacifica south coast saltscale	--/--/ CRPR 1B.2	Annual herb. Occurs on sea bluffs and playas of coastal bluff scrub, coastal sage scrub, and coastal dunes, usually in sandy soils. From sea level to 460 feet in elevation.	**Absent.** Sandy soils and disturbed coastal dunes present, but habitat quality poor due to anthropogenic influences; species not observed during surveys conducted when species would be conspicuous.	**High.** Suitable coastal bluff scrub habitat present and species has been documented within the San Onofre State Beach.	**High.** Suitable coastal sage scrub habitat present and species has been documented within the San Onofre State Beach.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Brodiaea filifolia thread-leaved brodiaea	FT/SE/ CRPR 1B.1	Perennial bulbiferous herb. Occurs in clay soils in chaparral (openings), cismontane woodland, coastal scrub, playas, valley and foothill grassland, and vernal pools. From 80 to 3,675 feet in elevation.	**Absent.** Suitable clay soils and habitat not present.	**Absent.** Suitable clay soils and habitat not present.	**Moderate.** Suitable coastal scrub and vernal pool habitat present. No historic occurrences documented within 1 mile of the site.
Calochortus weedii var. *intermedius* intermediate mariposa lily	--/--/ CRPR 1B.2	Perennial bulbiferous herb. Occurs in rocky, calcareous soils of chaparral, coastal scrub, and valley and foothill grassland. From 340 to 3,800 feet in elevation.	**Absent.** Suitable soils and habitat not present.	**Absent.** Suitable soils and habitat not present.	**Moderate.** Suitable coastal scrub and grassland habitat present. No historic occurrences documented within 1 mile of the site.
Chorizanthe polygonoides var. *longispina* long-spined spineflower	--/--/ CRPR 1B.2	Annual herb. Occurs in chaparral, coastal scrub, meadows and seeps, and valley and foothill grasslands, in gravelly soils at elevations from 100 to 5,000 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable soils and habitat not present.	**Moderate.** Suitable coastal scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.
Convolvulus simulans small-flowered morning-glory	--/--/ CRPR 4.2	Annual herb. Occurs in clay soils and on serpentinite seeps within chaparral (openings), coastal scrub, and valley and foothill grassland at elevations from 95 to 2,430 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name Common Name	Status Federal/State/ CNPS Rank	Habitat and Distribution	Potential to Occur		
			Sandy Beach	Bluff Face	Bluff Top
Deinandra paniculata paniculate tarplant	--/--/ CRPR 4.2	Annual herb. Occurs in usually vernally mesic, sometimes sandy within coastal scrub, valley and foothill grassland, and on vernal pools at elevations from 80 to 3,085 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub, grassland and vernal pool habitat is present. No historic occurrences documented within 1 mile of the site.
Dichondra occidentalis western dichondra	--/--/ CRPR 4.2	Perennial rhizomatous herb. Occurs in chaparral, cismontane woodland, coastal scrub, and Valley and foothill grassland at elevations from 160 to 1,640 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.
Dudleya blochmaniae subsp. *blochmaniae* Blochman's dudleya	--/--/ CRPR 1B.1	Perennial herb. Occurs in stony or rocky areas, slopes on grassy terraces, or in clay or serpentinite soils within habitats including coastal bluff scrub, chaparral, coastal scrub, and valley and foothill grasslands. Can be found at elevations up to 1,500 feet.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal bluff scrub habitat is present. No historic occurrences documented within 1 mile of the site.	**Moderate.** Suitable coastal scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.
Dudleya multicaulis many-stemmed dudleya	--/--/ CRPR 1B.2	Perennial herb. Occurs in clay soils within chaparral, coastal scrub, and valley and foothill grasslands at elevations up to 2,590 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Eryngium pendletonense Pendleton button-celery	--/--/ CRPR 1B.1	Annual/perennial herb. Occurs in clay soil, coastal bluffs, grassland, and coastal-sage scrub, primarily in vernal pools. Pendleton button-celery can be found at elevations up to 165 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Present.** This species is present within the fenced-in vernal pool habitat restoration area on the Bluff Top.
Harpagonella palmeri Palmer's grapplinghook	--/--/ CRPR 4.2	Annual herb. Occurs in clay soils within open grassy areas of chaparral, coastal scrub, and valley and foothill grassland at elevations from 65 to 3,135 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.
Hordeum intercedens vernal barley	--/--/ CRPR 3.2	Annual grass. This species occurs in vernal pools, dry, saline streambeds, and alkaline flats at elevations less than 1,650 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable habitat is present within the fenced-in vernal pool habitat restoration area. No historic occurrences documented within 1 mile of the site.
Isocoma menziesii var. *decumbens* decumbent goldenbush	--/--/ CRPR 1B.2	Perennial shrub. Occurs within sandy soils of chaparral and coastal scrub habitats often in disturbed areas. Can be found at elevations up to 445 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub habitat is present. No historic occurrences documented within 1 mile of the site.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Lasthenia glabrata subsp. *coulteri* Coulter's goldfields	--/--/ CRPR 1B.1	Annual herb. Occurs in in saline areas and damp alkaline spots. Habitat includes coastal salt marshes and swamps, playas, and vernal pools at elevations up to 4,000 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable habitat is present within the fenced-in vernal pool habitat restoration area. No historic occurrences documented within 1 mile of the site.
Lepidium virginicum var. *robinsonii* Robinson's pepper-grass	--/--/ CRPR 4.3	Annual herb. Occurs in chaparral and coastal scrub habitats at elevations up to 2,905 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub habitat is present. No historic occurrences documented within 1 mile of the site.
Lycium brevipes var. *hassei* Santa Catalina Island desert-thorn	--/--/ CRPR 3.1	Perennial shrub. Occurs in coastal bluff scrub along coastal bluffs at elevations up to 980 feet.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal bluff scrub habitat present. No historic occurrences documented within 1 mile of the site.	**Absent.** Suitable habitat not present.
Lycium californicum California box-thorn	--/--/ CRPR 4.2	Perennial shrub. Occurs in coastal sage and bluff scrub along coastal bluffs at elevations up to 500 feet.	**Absent.** Suitable habitat not present.	**Present.** This species is present within the coastal bluff scrub habitat on the Bluff Face.	**High.** Suitable coastal scrub habitat present. Species is present on the Bluff Face adjacent to the Bluff Top sub-area.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Microseris douglasii subsp. *platycarpha* small-flowered microseris	--/--/ CRPR 4.2	Annual herb. Occurs in clay soils within valley grasslands, foothill woodlands, and coastal sage scrub below 3,608 feet elevation. This species is often found in association with vernal pools.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal scrub, grassland, and vernal pool habitat is present. No historic occurrences documented within 1 mile of the site.
Myosurus minimus subsp. *apus* little mousetail	--/--/ CRPR 3.1	Annual herb. Occurs in valley and foothill grassland, and within alkaline vernal pools at elevations from 65 to 2,100 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**High.** Habitat is present within the grassland and vernal pool habitats. Species has been documented within the San Onofre State Beach area.
Navarretia prostrata prostrate vernal pool navarretia	--/--/ CRPR 1B.1	Annual herb. Occurs in alkaline floodplains and vernal pools within coastal sage scrub and wetland/riparian areas below 2,296 feet elevation.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal sage scrub and grassland habitat is present. No historic occurrences documented within 1 mile of the site.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Nolina cismontana chaparral nolina	--/--/ CRPR 1B.2	Perennial evergreen shrub. Occurs on sandstone or gabbro soils in chaparral and coastal scrub habitats at elevations from 455 to 4,185 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Low.** Marginally suitable habitat is present within the coastal scrub areas; however, elevation range of this species is above the range on site. No historic occurrences documented within 1 mile of the site.
Piperia cooperi chaparral rein orchid	--/--/ CRPR 4.2	Perennial herb. Occurs in chaparral, cismontane woodland, and valley and foothill grasslands at elevations from 45 to 5,200 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable habitat is present within the grassland areas. No historic occurrences documented within 1 mile of the site.
Pseudognaphalium leucocephalum white rabbit-tobacco	--/--/ CRPR 2B.2	Perennial herb. Occurs in sandy and gravelly soils of chaparral, cismontane woodland, coastal scrub, and riparian woodland at elevations up to 6,890 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable habitat is present within the coastal scrub areas. No historic occurrences documented within 1 mile of the site.

Table 2: Sensitive Terrestrial Plant Species Potentially Occurring on Project Site

Scientific Name **Common Name**	**Status Federal/State/ CNPS Rank**	**Habitat and Distribution**	**Potential to Occur**		
			Sandy Beach	**Bluff Face**	**Bluff Top**
Romneya coulteri Coulter's matilija poppy	--/--/ CRPR 4.2	Perennial rhizomatous herb. Occurs in chaparral and coastal scrub habitats often sprouting after a fire. Can be found at elevations from 65 to 3,935 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Low.** Limited habitat is present within the coastal scrub areas, but soils are lacking nutrients associated with burn areas. No historic occurrences documented within 1 mile of the site.
Senecio aphanactis chaparral ragwort	--/--/ CRPR 2B.2	Annual herb. Occurs in chaparral, cismontane woodland, and coastal scrub areas. Soils are often alkaline. Can be found at elevations from 45 to 2,625 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable habitat is present within the coastal scrub areas. No historic occurrences documented within 1 mile of the site.
Suaeda taxifolia woolly seablite	--/--/ CRPR 4.2	Perennial shrub. Occurs in coastal bluff scrub, coastal dunes, and margins of salt marshes and swamps. Species can be found at elevations up to 200 feet.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable coastal bluff scrub habitat present. No historic occurrences documented within 1 mile of the site.	**Absent.** Suitable habitat not present.
Viguiera laciniata San Diego County viguiera	--/--/ CRPR 4.3	Perennial shrub. Occurs in chaparral and coastal scrub at elevations from 195 to 2,460 feet.	**Absent.** Suitable habitat not present.	**Absent.** Suitable habitat not present.	**Moderate.** Suitable habitat is present within the coastal scrub areas. No historic occurrences documented within 1 mile of the site.

3.4 WILDLIFE

Although the Project site itself contains small patches of natural vegetation, San Onofre State Beach and the adjacent coastal bluffs provide habitat for a variety of terrestrial wildlife species, including insects, amphibians, reptiles, birds, and mammals. The CNDDB and literature review resulted in a list of 32 wildlife species (4 insects, 1 fish, 2 amphibians, 3 reptiles, 11 birds, 11 mammals) known to occur within USGS 7.5-minute quadrangles *San Onofre Bluff* and *San Clemente*, both of which contain the Project site. Due to the location of the Project along the coast and the project site overlapping the border of two quads, the results of only the species within these two quads are considered most relevant and are provided in this report. The list of species included in the 9-quad review are provided in Appendix D. The following paragraphs describe the wildlife species observed or otherwise detected or expected within or in the vicinity of the site during the reconnaissance-level survey. Wildlife detections or signs included those for birds, reptiles, and mammals. Species observed on the site are common in Developed and Sandy Beach areas and are also found in the vegetation communities discussed further in Section 3.3 above.

3.4.1 Invertebrates

The infaunal community in the general nearshore Project area is dominated in numbers of species and individuals by polychaete worms, mollusks, and crustaceans. The invertebrates at the Project site are expected to be similar to other San Diego County sandy beaches, which would include sand crabs (*Emerita analoga*), beach hoppers (*Megalorchestia* spp, *Orchestodea* spp.), amphipods (e.g., *Eohaustorius* spp.), isopods (e.g., *Excirolana* spp.), and other crustaceans; bean clam (e.g., *Donax gouldii*), Pismo clam (*Tivela stultorum*), and olive snail (*Olivella biplicata*) mollusks; bloodworm (*Euzonus mucronata*) and other polychaete worms (e.g., *Hemipodus borealis*., *Lumbrineris* spp., *Nephtys californiensis*, *Scololepis* spp.); and nemertean ribbon worms (SAIC 2011). In the upper rocky intertidal, barnacles (*Cthamalus* spp.), limpets (*Collisella, Lottia*), and periwinkles (*Littorina* spp.) are common in San Diego. In the lower rocky intertidal, California mussel (*Mytilus californus*), gooseneck barnacle (*Pollicipes polymerus*), aggregating sea anemones (*Anthopleura elegantissima*), hermit crabs (e.g., *Pagurus* spp.), lined shore crab (*Pachygrapsus crassipes*), a variety of snails (e.g., *Lithopoma* spp., *Kelletia kellitia*, *Tegula* spp.), and chitons (e.g., *Mopalia mucosa*, *Nutallina* spp). In the lower mixed intertidal zones, sea anemones (*Pachycerianthus fimbriatus*), purple sea urchins (*Strongylocentrotus purpuratus*), sea hares (*Aplysia californica),* sea stars (*Pisaster brevispinus),* and the California spiny lobster (*Panulirus interruptus)* are expected. Common species in the shallow subtidal of the San Diego region include burrowing anemones, crabs, sea pansy, sea pen, clams, snails, sand dollar, sand stars, and tube worms (SAIC 2011).

3.4.2 Fish and Essential Fish Habitat

The Essential Fish Habitat (EFH) Mapper (NOAA 2018) identified the entire Project coastline as EFH for all lifestages for Finfish and Market Squid, Krill – Thysonoessa Spinifera, Krill – Euphausia Pacifica, Other Krill Species, Coastal Pelagic Species, and Groundfish. The EFH Mapper identified there are no Pacific Salmon EFH, no Habitat Areas of Particular Concern, and no EFH Areas Protected from FIshing. MarineBIOS (CDFW 2018) identifies the entire Project coastline as Rocky Shores.

Based on a survey conducted via beach seine of the San Diego coastline for the JLOTS EA, 39 different species (36 fish and 3 invertebrate) were collected (Enercon 2014). Abundant species collected were topsmelt (*Atherinops affinis*), California corbina (*Menticirrhus undulatus*), dwarf perch (*Micrometrus* *minimus*), walleye surfperch (*Hyperprosopon argenteum*), queenfish (*Seriphus politus*), barred surfperch (*Amphistichus argenteus*), spotfin croaker (*Roncador stearnsii*), bat ray (*Myliobatis californica*), and round stingray (*Urobatis halleri*). Additional fish species that would be expected in the mixed sand and rock habitat offshore San Onofre beaches include California halibut (*Paralichthys californicus*), lizard fish (*Synodus lucioceps*), barred sandbass (*Paralabrax nebulifer*), and northern anchovy (*Engraulis mordax*), barred surfperch (*Amphisticus argenteus*), and California grunion (*Leuresthes tenuis*).

The most abundant larval fish taxa collected in all offshore samples were northern anchovy (Engraulis mordax); California grunion (Leuresthes tenuis); unidentified silversides (Atherinopsidae); and jacksmelt (Atherinopsis californiensis). Shoreline surface samples were dominated by grunion, silversides, jacksmelt, and kelpfishes (Clinidae). (Enercon 2014)

California grunion spawn on southern California sand beaches between March and September during the highest nighttime tides. Grunion on San Diego beaches are typically found on the long, gently sloping beaches with moderately fine grain size and sand depths typically ranging up to 2 to 3 feet (CSLC 2005). San Onofre State Beach is an area that is expected to have low to no grunion spawning (e.g., Walker Scale W=0 and W=1) on an annual basis due to the narrow or no beach exposed at high tide, especially in the areas where the emergency revetment was placed because there is limited to no sand for the grunion to spawn at the high tide line (Dugan and Hubbard 2008).

3.4.3 Reptiles

A total of one reptile species, western fence lizard (Sceloporus occidentalis), was observed or otherwise detected during the survey.

No sensitive reptile species were observed or detected on or in the vicinity of the Project site during the survey.

3.4.4 Birds

A total of 15 avian species, including the federally threatened coastal California gnatcatcher (*Polioptila californica californica*), were observed or otherwise detected during the survey. These species included brown pelican (*Pelecanus occidentalis californicus*), western gull (*Larus occidentalis*), Anna's hummingbird (*Calypte anna*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), house finch (*Carpodacus mexicanus*), song sparrow (*Melospiza melodia*), white-throated swift (*Aeronautes saxatalis*), black phoebe (*Sayornis nigricans*), European starling (*Sturnus vulgaris*), great-tailed grackle (*Quiscalus mexicanus*), California towhee (*Melozone crissalis*), white-crowned sparrow (*Zonotrichia leucophrys*), and lesser goldfinch (*Spinus psaltria*). In addition, although not observed during the 2018 survey, Heerman's (*Larus heermanni*) and herring (*L. argentatus*) gulls; marbled godwit (*Limosa fedoa*), sanderlings (*Calidris alba*), willets (*Tringa semipalmata*), great egret (*Ardea alba*); and rock pigeon (*Columba livia*) are expected to occur in the Study Area (SAIC 2011).

3.4.5 Mammals

A total of four terrestrial mammal species, California ground squirrel (*Spermophilus beecheyi*), domestic dog (*Canis familiaris*), coyote (*Canis latrans*), and gray fox (*Urocyon cinereoargenteus*) were observed or otherwise detected during the survey. Although not observed during the survey, common terrestrial mammal species, including gopher (*Thomomys bottae sanctidiegi*), mice (e.g., *Mus musculus*), black rat

(*Rattus rattus*), Norway rat (*R. norvegicus*), opossum (*Didelphis virginiana*), rabbits (*Sylvilagus* spp.), California ground squirrel (*Spermophilus beecheyi nudipes*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*) would also be expected within the coastal bluffs or backbeach shoreline of the Project site.

Although cetaceans are commonly observed in the open water in the general area at San Onofre State Beach, including California grey whale (*Eschrichtius robustus*), bottlenose dolphin (*Tursiops truncates*), and long-beaked common dolphin (*Delphinus capensis*) (Enercon 2014), no marine mammals were observed during the survey. Two pinnipeds, the California sea lion (*Zalophus californianus*) and the harbor seal (*Phoca vitulina*), also are frequent visitors to the nearshore area, but were not observed during the survey.

3.4.6 Sensitive Wildlife

The CNDDB resulted in a list of 32 sensitive wildlife species known to occur on or within the *San Onofre Bluff*, and *San Clemente* USGS 7.5 minute quads containing the Project site (Appendix D). Of these 44 sensitive wildlife species, 11 are federally and/or state listed as endangered or threatened. After a literature review and the assessment of the various habitat types on the Project site and within the surrounding SA, 18 sensitive wildlife species were considered **absent** from the Project site due to lack of suitable habitat.

Arroyo toad (*Branchinecta sandiegonensis*), Dulzura pocket mouse (*Chaetodipus californicus femoralis*), northwestern San Diego pocket mouse (*Chaetodipus fallax fallax*), Pacific pocket mouse (*Perognathus longimembris pacificus*), and monarch – California overwintering population (*Danaus plexippus* pop. 1) are known to occur near the Study Area, but due to quality and quantity of suitable habitat and/or limited access from areas where they are known to occur, these species would be expected to have **low** potential to occur in the Project area.

California least tern (*Sternula antillarum browni*), coastal cactus wren (*Campylorhynchus brunneicapillus sandiegensis*), California glossy snake (Arizona elegans occidentalis), coast horned lizard (*Phrynosoma blainvillii*), and San Diego desert woodrat (Neotoma lepida intermedia) would be expected to have **moderate to high** potential to occur in the Project area. Although not observed within the *San Clemente* or *San Onofre Bluffs* quads in the CNDDB database, western snowy plover (*Charadrius alexandrinus nivosus*) also may have a **moderate** potential for foraging at the site.

Four species were recorded in the CNDDB within the Study Area: San Diego fairy shrimp (Branchinecta sandiegonensis), burrowing owl (*Athene cunicularia*), globose dune beetle (*Coelus globosus*), and are considered **present**. One sensitive species, coastal California gnatcatcher (*Polioptila californica californica*), was observed during the survey and is **present** in the Project area within the Beach/Bluff Face sub-area of the SA.

Coastal California gnatcatcher

The coastal California gnatcatcher (CAGN) is a federally threatened species and a California Species of Special Concern. The range of this species extends from southern California west of the Peninsular and Transverse ranges south into northwestern Baja California, Mexico. The CAGN has a short and slender bill and a white eye ring. The tail is mostly black with white edges, grayish overall, and the back and wings grey with brown tinge. Breeding males have a black cap. It is a permanent resident of Diegan, Riversidian, and Venturan varieties of coastal sage scrub found from sea level to 2,500 feet in elevation. The species lives and breeds within California sagebrush dominant habitats and also occurs in mixed scrub habitats with lesser percentages of this favored shrub (Atwood and Bontrager 2001).

Western snowy plover

Western snowy plover is federally listed as threatened and is found on sandy beaches, estuaries, salt pond levees, and shores of large alkali lakes. This species needs sandy, gravelly, or friable soils for nesting. The nearest snowy plover nesting areas to San Onofre State Beach are in the Bolsa Chica Wetlands to the north and on Camp Pendleton to the south. Snowy plovers do not breed at San Onofre State Beach; however, wintering snowy plovers are expected to occur at San Onofre State Beach and may occasionally forage in the Seaward sub-area of the Project area. During monitoring of a test well for the Dana Point Ocean Desalination Project between January 30 and April 24, 2006, up to 11 snowy plovers were observed foraging and roosting next to the San Juan Creek jetty on Doheny State Beach on February 22 through February 24 (McEntee 2006). In addition, snowy plovers were observed 0.5 mile downcoast on an almost daily basis during monitoring. Snowy plovers are considered to have a **moderate** potential to winter at San Onofre State Beach.

Sea Turtles

Four species of sea turtles listed by the federal government have a **low** potential to occur in Project area waters. These species are the federally listed as threatened loggerhead sea turtle (*Caretta caretta*), the federally listed as threatened Pacific Ridley sea turtle (*Lepidochelys olivacea*), the federally listed as threatened green sea turtle (*Chelonian mydas*), and the federally listed as endangered leatherback sea turtle (*Dermochelys coriacea*). All of these turtles have the centers of their populations elsewhere, but they are seen occasionally off the southern California coast. Leatherback sea turtles are the most common sea turtle in United States waters north of Mexico. The National Marine Fisheries Service recently has designated Critical Habitat for leatherback sea turtles (NMFS 2012); however, the Orange County coast is not within the designated Critical Habitat.

Marine Mammals

Two species of pinniped federally designated as threatened and six species of whales federally listed as endangered have a **low** potential to occur in the nearshore waters off San Onofre State Beach. The threatened pinnipeds are the Guadalupe fur seal (*Arctocephalus townsendi*) and the Stellar sea lion (*Eumetopias jubatus*). The endangered whales are blue whale (*Balaenoptera musculus*), sei whale (*B. borealis*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Balaena glacialis*), and sperm whale (*Physeter macrocephalus*). Although any of these species potentially could occur in Project area waters, their presence would be unlikely.

SECTION 4.0 – CONCLUSIONS

This section summarizes the findings of the biological reconnaissance-level surveys of the project site. Based on the assessment of various habitats present within the three sub-areas within the Study Area, the Project site may support Environmentally Sensitive Habitat Area (ESHA), as described by the County of San Diego, which defines ESHA as "[a]ny land in which plant or animal life or their habitats are either rare or especially valuable because of their nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments is defined to be an Environmentally Sensitive Habitat Area, or ESHA, consistent with Coastal Act Section 30107.5 (County of San Diego 2017)." Specifically, the habitat on the Bluff Face and Bluff Top are known to support sensitive plant and/or wildlife species and potentially may support additional sensitive species not observed or documented in available databases. Focused surveys for these additional species would be required to confirm absence or presence.

4.1 MARINE RESOURCES

The predominantly cobble nearshore is known to support patches of kelp, including feather boa kelp and southern palm kelp, as well as possible surfgrass along the entire Survey Area. Although not listed as a federally or state listed as threatened or endangered, sensitive, or protected species, these species are considered important species along the southern California coastline. Marine invertebrates in the area include polychaetes, echinoderms, sea pens, anemones, sea pansies, gastropods, mollusks, and crustaceans, including spiny lobster. Fish expected within the nearshore Project site are topsmelt, California corbina, dwarf perch, walleye surfperch, queenfish, barred surfperch, spotfin croaker, bat ray, and round stingray. Additional fish species that would be expected in the mixed sand and rock habitat offshore San Onofre beaches include California halibut, lizard fish, barred sandbass, and northern anchovy, barred surfperch, and California grunion. Cetaceans may be observed in the open water in the general nearshore area includw California grey whale, bottlenose dolphin, and common dolphin, as well as the pinnipeds California sea lion and harbor seal.

4.2 SENSITIVE PLANTS

The CNDDB and CNPSEI literature reviews resulted in a list of 92 sensitive plant species that have a potential to occur on the Project site, of which 34 species are known to occur within one of the two quads containing the Project site. Of the 34 special status plants that were evaluated for their potential occurrence on site, 5 species are considered absent from all three sub-areas, 2 species have a low potential for occurrence, 23 species have a moderate potential to occur, 2 species have a high potential, and 2 species were observed (see Table 2). One of the 29 sensitive plants either having a low, moderate, or high potential for occurrence or were observed, one species is federally or state listed as threatened or endangered (thread-leaved brodiaea, *Brodiaea filifolia*). San Diego button-celery (*Eryngium aristulatum* var*. parishii*) was observed within the Bluff Top sub-area and California box-thorn (*Lycium californicum*) was observed on the Bluff Face sub-area. In addition, the NWI shows a Freshwater Emergent Wetland is located at the base of the bluff on the northwest side of the SA. There is no potential for any sensitive plant species to occur on the Sandy Beach or within the Seaward sub-area of the Project site.

4.3 SENSITIVE WILDLIFE

Monarch – California overwintering population, arroyo toad, Dulzura pocket mouse, northwestern San Diego pocket mouse, and Pacific pocket mouse are known to occur near the Study Area and have a potential to occur in the coastal sage scrub present on the coastal bluff (Bluff Face and Bluff Top), but due to quality and quantity of suitable habitat and/or limited access from areas where they are known to occur, these species would be expected to have low potential to occur in the Study Area.

Based on observations along the coast nearby, California glossy snake, coast horned lizard, California least tern, coastal cactus wren, western snowy plover, and San Diego desert woodrat would be expected to have moderate to high potential to occur in the SA. These bird species are expected to forage in the area, but are not expected to be nesting at the Project site.

Four species were either observed or recorded to occur in the CNDDB within the Study Area: San Diego fairy shrimp, burrowing owl, and globose dune beetle; coastal California gnatcatcher was observed within the Study Area during the reconnaissance survey. In addition, a portion of the Bluff Top has been designated a Critical Habitat for San Diego fairy shrimp.

SECTION 5.0 – LIST OF PREPARERS

Lisa Louie
Senior Project Manager/Biologist

Mike McEntee
Principal Biologist

Heather Clayton
Senior Biologist/Botanist

Jeremy Smith
Biologist/Botanist

Jackelyn Mayfield
Biologist/Botanist

Michael Simmons
GIS Analyst

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APPENDIX A – PLANT SPECIES OBSERVED

APPENDIX A
PLANT SPECIES OBSERVED

Scientific Name	Common Name
GYMNOSPERMS	
ARAUCARIACEAE	**ARAUCARIA FAMILY**
*Araucaria columnaris**	New Caledonia pine
PINACEAE	**PINE FAMILY**
*Pinus halepensis**	Aleppo pine
ANGIOSPERMS (EUDICOTS)	
ADOXACEAE	**MUSKROOT FAMILY**
Sambucus nigra subsp. *caerulea*	blue elderberry
AIZOACEAE	**FIG-MARIGOLD FAMILY**
*Carpobrotus chilensis**	sea-fig
*Malephora crocea**	crocea iceplant
*Mesembryanthemum crystallinum**	crystalline iceplant
*Mesembryanthemum nodiflorum**	slender-leaved iceplant
*Tetragonia tetragonioides**	New Zealand spinach
ANACARDIACEAE	**SUMAC OR CASHEW FAMILY**
Malosma laurina	laurel sumac
Rhus integrifolia	lemonadeberry
APIACEAE	**CARROT FAMILY**
*Conium maculatum**	poison hemlock
Daucus pusillus	rattlesnake weed
Eryngium pendletonense	Pendleton button-celery
*Foeniculum vulgare**	fennel
Sanicula sp.	sanicle
ARALIACEAE	**GINSENG FAMILY**
*Schefflera actinophylla**	Australia umbrella tree
ASTERACEAE	**SUNFLOWER FAMILY**
Amblyopappus pusillus	pineapple weed
Ambrosia chamissonis	beach bur-sage
Artemisia californica	California sagebrush
Baccharis pilularis	coyote brush
Baccharis salicifolia subsp. *salicifolia*	mule fat
*Centaurea melitensis**	tocalote
*Chrysanthemum multicaule**	golden raindrop daisy
Deinandra fasciculata	fascicled tarweed
Encelia californica	California bush sunflower
Isocoma menziesii	coast goldenbush
Laennecia coulteri	Coulter's fleabane

Scientific Name	Common Name
Logfia filaginoides	California fluffweed
Pseudognaphalium biolettii	bicolored cudweed
Pseudognaphalium californicum	California everlasting
Psilocarphus brevissimus	woolly marbles
*Senecio mandraliscae**	blue chalk stick
BORAGINACEAE	**BORAGE FAMILY**
Amsinckia menziesii	common fiddleneck
Heliotropium curassavicum var. *oculatum*	salt heliotrope
Plagiobothrys sp.	popcornflower
BRASSICACEAE	**MUSTARD FAMILY**
*Cakile maritima**	sea rocket
*Hirschfeldia incana**	shortpod mustard
*Lepidium didymum**	wart cress
Lepidium nitidum	shining peppergrass
CACTACEAE	**CACTUS FAMILY**
Cylindropuntia prolifera	coast cholla
Opuntia littoralis	coastal prickly pear
CARYOPHYLLACEAE	**PINK FAMILY**
Silene sp.	catchfly
CHENOPODIACEAE	**GOOSEFOOT FAMILY**
Atriplex canescens	four-wing saltbush
Atriplex lentiformis	big saltbush
Atriplex lindleyi subsp. *linleyi**	Lindley's saltbush
*Atriplex semibaccata**	Australian saltbush
*Salsola tragus**	Russian thistle
CLEOMACEAE	**SPIDERFLOWER FAMILY**
Peritoma arborea	bladderpod
CRASSULACEAE	**STONECROP FAMILY**
*Crassula ovata**	jade plant
Dudleya lanceolata	lance-leaved dudleya
*Sempervivum tectorum**	common houseleek
CUCURBITACEAE	**GOURD FAMILY**
Marah macrocarpa	wild cucumber
DIDIEREACEAE	**DIDIEREA FAMILY**
*Portulacaria afra**	elephant bush
EUPHORBIACEAE	**SPURGE FAMILY**
*Ricinus communis**	castor-bean
FABACEAE	**LEGUME FAMILY**
*Acacia melanoxylon**	blackwood acacia

Scientific Name	Common Name
Acmispon glaber var. *glaber*	coastal deerweed
*Medicago polymorpha**	bur clover
GERANIACEAE	**GERANIUM FAMILY**
*Erodium cicutarium**	red-stemmed filaree
*Erodium moschatum**	white-stemmed filaree
*Pelargonium peltatum**	ivy geranium
*Pelargonium quercifolium**	oakleaf geranium
LAMIACEAE	**MINT FAMILY**
Salvia mellifera	black sage
LYTHRACEAE	**LOOSESTRIFE FAMILY**
Lythrum californicum	California loosestrife
MALVACEAE	**MALLOW FAMILY**
Malacothamnus fasciculatus	mesa bushmallow
*Malva parviflora**	cheeseweed
MONTIACEAE	**MINER'S LETTUCE FAMILY**
Calandrinia ciliata	red maids
Claytonia perfoliata subsp. *perfoliata*	Miner's-lettuce
MORACEAE	**MULBERRY FAMILY**
*Ficus benjamina**	weeping fig
MYRTACEAE	**MYRTLE FAMILY**
*Eucalyptus globulus**	blue gum
NYCTAGINACEAE	**FOUR O'CLOCK FAMILY**
Mirabilis laevis var. *crassifolia*	California wishbone bush
OXALIDACEAE	**OXALIS FAMILY**
*Oxalis pes-caprae**	Bermuda buttercup
PHRYMACEAE	**LOPSEED FAMILY**
Mimulus aurantiacus	orange bush monkey-flower
PLUMBAGINACEAE	**LEADWORT FAMILY**
*Limonium perezii**	Perez's marsh-rosemary
POLYGONACEAE	**BUCKWHEAT FAMILY**
Eriogonum fasciculatum	California buckwheat
Eriogonum parviflorum	coast buckwheat
*Rumex crispus**	curly dock
RUBIACEAE	**MADDER FAMILY**
Galium aparine	goose grass
SCROPHULARIACEAE	**FIGWORT FAMILY**
*Myoporum laetum**	myoporum
SOLANACEAE	**NIGHTSHADE FAMILY**
Lycium californicum	California box-thorn

Scientific Name	Common Name
Solanum douglasii	Douglas' nightshade
ANGIOSPERMS (MONOCOTS)	
AGAVACEAE	**AGAVE FAMILY**
*Agave americana**	century plant
*Agave attenuata**	agave
*Yucca elephantipes**	giant yucca
ARACEAE	**PHILODENDRON FAMILY**
*Philodendron bipinnatifidum**	tree philodendron
ARECACEAE	**PALM FAMILY**
*Phoenix canariensis**	Canary Island date palm
*Washingtonia robusta**	Mexican fan palm
ASPARAGACEAE	**ASPARAGUS FAMILY**
*Asparagus densiflorus**	asparagus fern
Chlorophytum comosum 'Variegatum'*	spider plant
ASPHODELACEAE	**ASPHODEL FAMILY**
*Aloe vera**	medicinal aloe
IRIDACEAE	**IRIS FAMILY**
Sisyrinchium bellum	blue-eyed grass
POACEAE	**GRASS FAMILY**
*Arundo donax**	giant reed
*Bromus diandrus**	ripgut grass
*Bromus hordeaceus**	soft chess
Bromus madritensis subsp. *madritensis**	foxtail chess
Distichlis spicata	saltgrass
Elymus condensatus	giant wild rye
Festuca microstachys	small fescue
*Hordeum murinum**	glaucous foxtail barley
Melica imperfecta	coast range melic
*Polypogon monspeliensis**	annual beard grass
*Stenotaphrum secundatum**	Saint Augustine grass
Stipa pulchra	purple needlegrass
STRELITZIACEAE	**BIRD OF PARADISE FAMILY**
*Strelitza nicolai**	giant bird of paradise
*Strelitzia reginae**	bird of paradise
THEMIDACEAE	**BRODIAEA FAMILY**
Bloomeria crocea	common goldenstar
Dichelostemma capitatum	blue dicks

*Non-Native Species

APPENDIX B – WILDLIFE SPECIES OBSERVED/DETECTED

APPENDIX B
WILDLIFE SPECIES OBSERVED

Scientific Name	Common Name
CLASS REPTILIA	**REPTILES**
PHRYNOSOMATIDAE	**ZEBRA-TAILED, EARLESS, FRINGE-TOED, SPINY, TREE, SIDE-BLOTCHED, AND HORNED LIZARDS**
Sceloporus occidentalis	western fence lizard
CLASS AVES	**BIRDS**
PELECANIDAE	**PELICANS**
Pelecanus occidentalis	brown pelican
LARIDAE	**SKUAS, GULLS, TERNS, SKIMMERS**
Larus occidentalis	western gull
APODIDAE	**SWIFTS**
Aeronautes saxatalis	white-throated swift
TROCHILIDAE	**HUMMINGBIRDS**
Calypte anna	Anna's hummingbird
TYRANNIDAE	**TYRANT FLYCATCHERS**
Sayornis nigricans	black phoebe
CORVIDAE	**JAYS & CROWS**
Corvus brachyrhynchos	American crow
Corvus corax	common raven
POLIOPTILIDAE	**GNATCATCHERS**
Polioptila californica californica	coastal California gnatcatcher
STURNIDAE	**STARLINGS**
Sturnus vulgaris	European starling
ICTERIDAE	**BLACKBIRDS**
Quiscalus mexicanus	great-tailed grackle
EMBERIZIDAE	**EMBERIZIDS**
Melospiza melodia	song sparrow
Melozone crissalis	California towhee
Zonotrichia leucophrys	white-crowned sparrow
FRINGILLIDAE	**FINCHES**
Spinus psaltria	lesser goldfinch
Carpodacus mexicanus	house finch
SCIURIDAE	**SQUIRRELS**
Spermophilus beecheyi	California ground squirrel
CANIDAE	**WOLVES & FOXES**
Canis familiaris	domestic dog

Scientific Name	Common Name
Canis latrans	coyote (scat)
Urocyon cinereoargenteus	gray fox

APPENDIX C – SITE PHOTOGRAPHS

APPENDIX C
SITE PHOTOGRAPHS

PP1. Photo taken facing northwest depicting unvegetated revetment at northern end of Project site.

PP2. Photo taken facing northwest depicting large native quailbush (*Atriplex lentiformis*) shrubs associated with Quailbush Scrub habitat.

	**PP3.** Photo taken facing north depicting palm trees (*Washingtonia robusta*) growing seaward of the parking lot.
	**PP4.** Photo taken facing southeast depicting unvegetated Sandy Beach southeast of the parking area.

	**PP5.** Photo taken facing west depicting a small patch of Saltgrass Flats containing native saltgrass (*Distichlis spicata*) and Giant Reed/Exotics vegetation with a palm tree.
	**PP6**. Photo taken facing northwest along the shore seaward of the parking lot. Patches of giant reed (*Arundo donax*) were observed growing throughout the Sandy Beach area.

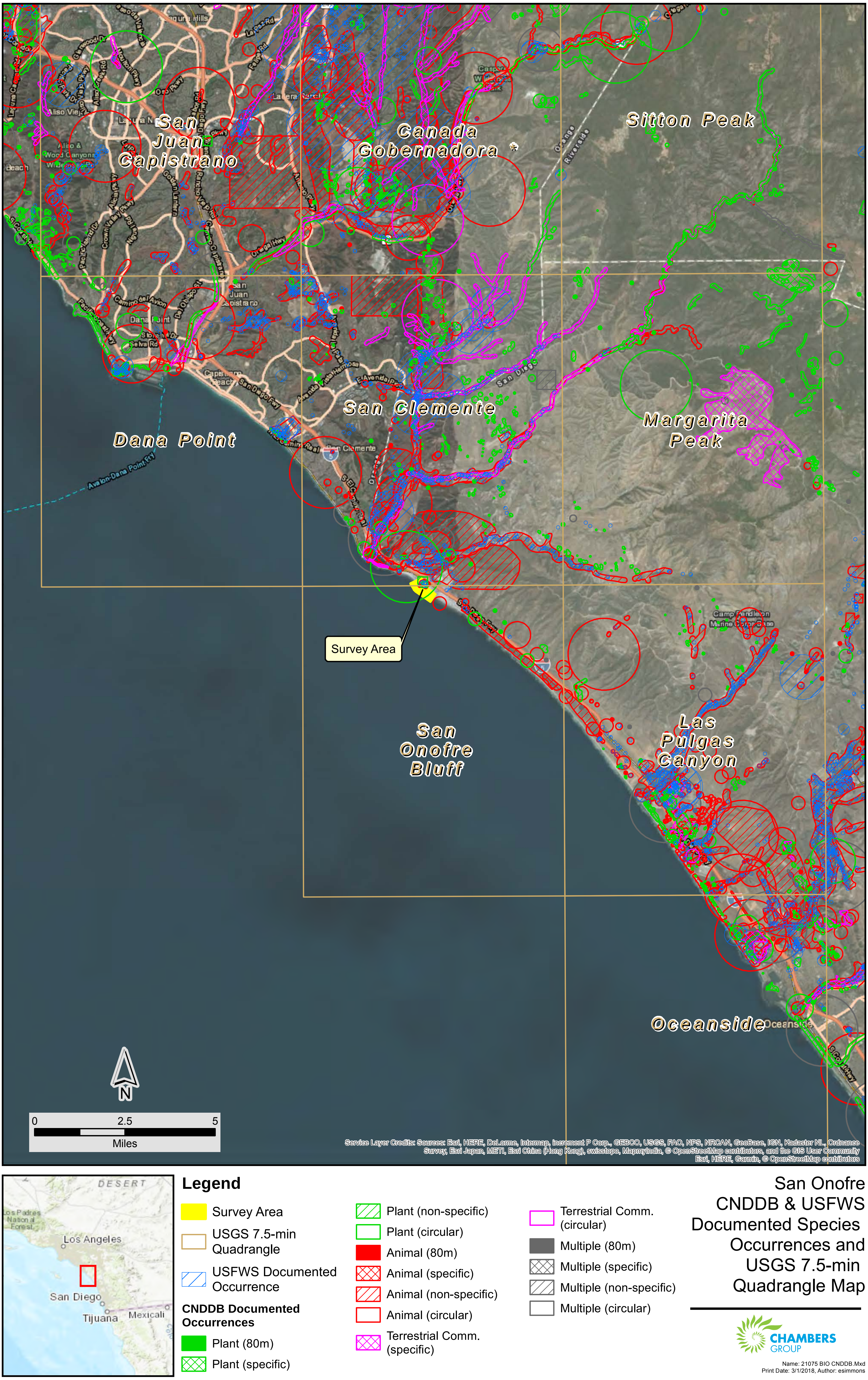
	**PP7.** Photo taken facing west at the southern end of the revetment within the Survey Area depicting Ornamental / Mixed Native Landscaping.
	**PP8.** Photo taken facing east depicting Disturbed Coastal Sage Scrub habitat in the foreground with Native Grassland areas near the top of the slope in the upper right side of the photo. This area is located on the north side of the San Onofre Mesa, outside the Survey Area.

	**PP9.** Photo taken facing south depicting disturbed portion of the Southern Coastal Bluff Scrub. This area is dominated by non-native crocea iceplant (*Malephora crocea*).
	**PP10.** Photo taken facing southeast depicting Southern Coastal Bluff Scrub vegetation landward of the parking lot, and Ornamental/Exotic vegetation seaward of the parking lot.

	**PP11.** Photo taken facing north depicting Southern Coastal Bluff Scrub vegetation with scattered patches of non-native sea-fig (*Carpobrotus chilensis*) shown in the bright green color.
	**PP12.** Photo taken facing north depicting dense high-quality Southern Coastal Bluff Scrub vegetation landward of the parking lot.

PP13. Photo taken facing northeast at the southeast end of the Survey Area depicting Southern Coastal Bluff Scrub vegetation and barren eroded portions.

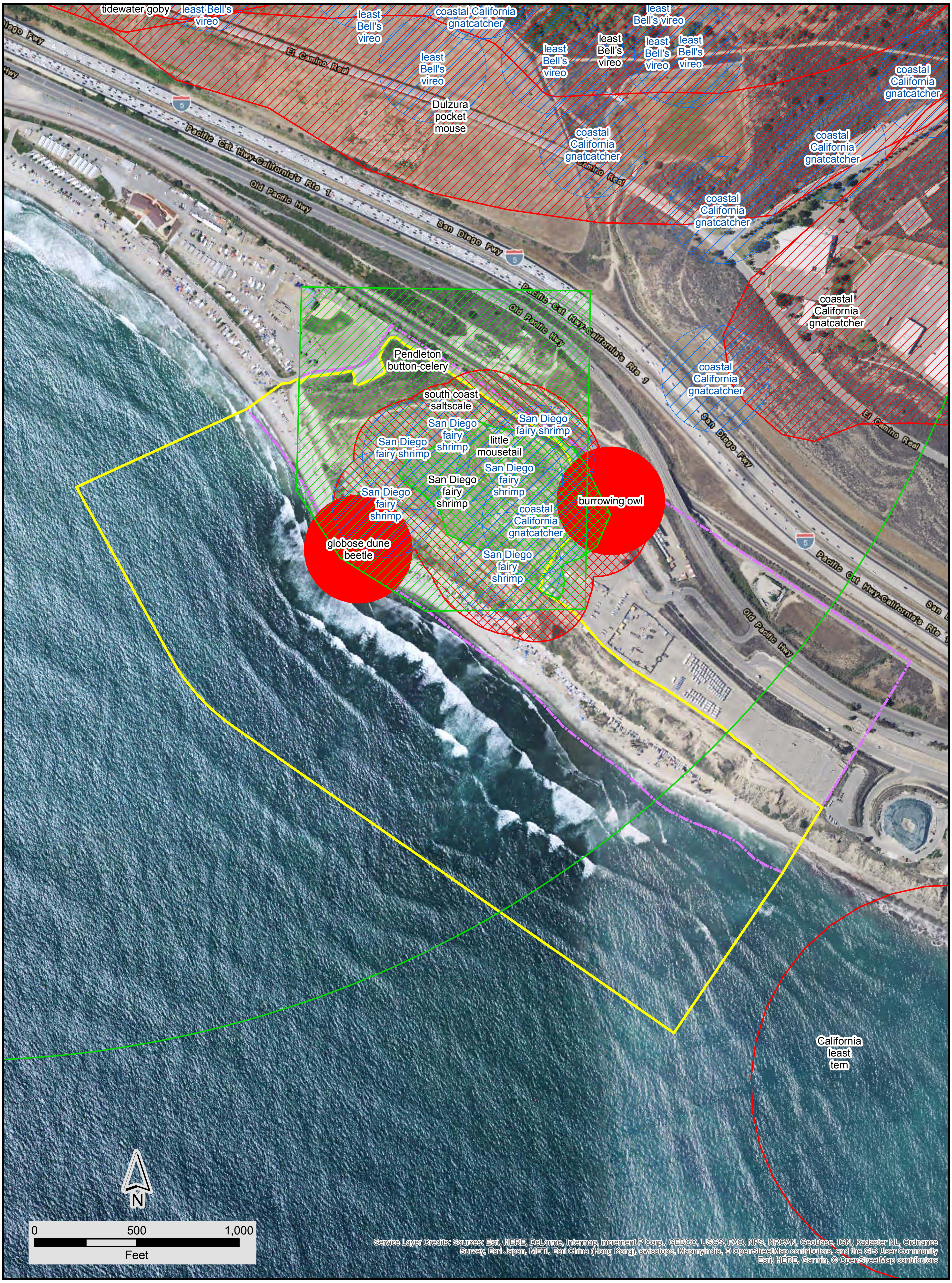
APPENDIX D – CNDDB AND CNPSEI DATABASE RESULTS



San Onofre CNDDB & USFWS Documented Species Occurrences and USGS 7.5-min Quadrangle Map

CHAMBERS GROUP

Name: 21075 BIO CNDDB.Mxd
Print Date: 3/1/2018, Author: esimmons



Legend

Survey Area

San Onofre State Beach

USFWS Documented Occurrence

CNDDB Documented Occurrences

Plant (specific)

Plant (non-specific)

Plant (circular)

Animal (80m)

Animal (specific)

Animal (non-specific)

Animal (circular)

San Onofre CNDDB & USFWS Documented Species Occurrences

CHAMBERS GROUP

Name: 21075 BIO CNDDB.Mxd
Print Date: 5/16/2018, Author: esimmons

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (San Clemente (3311745) OR Dana Point (3311746) OR San Juan Capistrano (3311756) OR Canada Gobernadora (3311755) OR Sitton Peak (3311754) OR Margarita Peak (3311744) OR Las Pulgas Canyon (3311734) OR Oceanside (3311724) OR San Onofre Bluff (3311735))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S4	WL
Acmispon prostratus Nuttall's acmispon	PDFAB2A0V0	None	None	G1G2	S1	1B.1
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Candidate Endangered	G2G3	S1S2	SSC
Aimophila ruficeps canescens southern California rufous-crowned sparrow	ABPBX91091	None	None	G5T3	S3	WL
Ambrosia pumila San Diego ambrosia	PDAST0C0M0	Endangered	None	G1	S1	1B.1
Ammodramus savannarum grasshopper sparrow	ABPBXA0020	None	None	G5	S3	SSC
Anaxyrus californicus arroyo toad	AAABB01230	Endangered	None	G2G3	S2S3	SSC
Antrozous pallidus pallid bat	AMACC10010	None	None	G5	S3	SSC
Aphanisma blitoides aphanisma	PDCHE02010	None	None	G3G4	S2	1B.2
Aquila chrysaetos golden eagle	ABNKC22010	None	None	G5	S3	FP
Arctostaphylos rainbowensis Rainbow manzanita	PDERI042T0	None	None	G2	S2	1B.1
Arizona elegans occidentalis California glossy snake	ARADB01017	None	None	G5T2	S2	SSC
Asio otus long-eared owl	ABNSB13010	None	None	G5	S3?	SSC
Aspidoscelis hyperythra orange-throated whiptail	ARACJ02060	None	None	G5	S2S3	WL
Aspidoscelis tigris stejnegeri coastal whiptail	ARACJ02143	None	None	G5T5	S3	SSC
Astragalus tener var. titi coastal dunes milk-vetch	PDFAB0F8R2	Endangered	Endangered	G2T1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC
Atriplex coulteri Coulter's saltbush	PDCHE040E0	None	None	G3	S1S2	1B.2

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Atriplex pacifica south coast saltscale	PDCHE041C0	None	None	G4	S2	1B.2
Baccharis vanessae Encinitas baccharis	PDAST0W0P0	Threatened	Endangered	G1	S1	1B.1
Bombus crotchii Crotch bumble bee	IIHYM24480	None	None	G3G4	S1S2	
Branchinecta sandiegonensis San Diego fairy shrimp	ICBRA03060	Endangered	None	G2	S2	
Brodiaea filifolia thread-leaved brodiaea	PMLIL0C050	Threatened	Endangered	G2	S2	1B.1
Brodiaea orcuttii Orcutt's brodiaea	PMLIL0C0B0	None	None	G2	S2	1B.1
Brodiaea santarosae Santa Rosa Basalt brodiaea	PMLIL0C0G0	None	None	G1	S1	1B.2
Buteo swainsoni Swainson's hawk	ABNKC19070	None	Threatened	G5	S3	
Calochortus weedii var. intermedius intermediate mariposa-lily	PMLIL0D1J1	None	None	G3G4T2	S2	1B.2
Campylorhynchus brunneicapillus sandiegensis coastal cactus wren	ABPBG02095	None	None	G5T3Q	S3	SSC
Centromadia parryi ssp. australis southern tarplant	PDAST4R0P4	None	None	G3T2	S2	1B.1
Centromadia pungens ssp. laevis smooth tarplant	PDAST4R0R4	None	None	G3G4T2	S2	1B.1
Chaenactis glabriuscula var. orcuttiana Orcutt's pincushion	PDAST20095	None	None	G5T1T2	S1	1B.1
Chaetodipus californicus femoralis Dulzura pocket mouse	AMAFD05021	None	None	G5T3	S3	SSC
Chaetodipus fallax fallax northwestern San Diego pocket mouse	AMAFD05031	None	None	G5T3T4	S3S4	SSC
Charadrius alexandrinus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2S3	SSC
Choeronycteris mexicana Mexican long-tongued bat	AMACB02010	None	None	G4	S1	SSC
Chorizanthe polygonoides var. longispina long-spined spineflower	PDPGN040K1	None	None	G5T3	S3	1B.2
Circus cyaneus northern harrier	ABNKC11010	None	None	G5	S3	SSC
Clinopodium chandleri San Miguel savory	PDLAM08030	None	None	G2	S2	1B.2
Coastal Brackish Marsh Coastal Brackish Marsh	CTT52200CA	None	None	G2	S2.1	

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Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Coleonyx variegatus abbotti San Diego banded gecko	ARACD01031	None	None	G5T3T4	S1S2	SSC
Comarostaphylis diversifolia ssp. diversifolia summer holly	PDERI0B011	None	None	G3T2	S2	1B.2
Crotalus ruber red-diamond rattlesnake	ARADE02090	None	None	G4	S3	SSC
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	None	None	G4T2T3	S2S3	
Diadophis punctatus similis San Diego ringneck snake	ARADB1001A	None	None	G5T2T3	S2?	
Dipodomys stephensi Stephens' kangaroo rat	AMAFD03100	Endangered	Threatened	G2	S2	
Dudleya blochmaniae ssp. blochmaniae Blochman's dudleya	PDCRA04051	None	None	G3T2	S2	1B.1
Dudleya multicaulis many-stemmed dudleya	PDCRA040H0	None	None	G2	S2	1B.2
Dudleya stolonifera Laguna Beach dudleya	PDCRA040P0	Threatened	Threatened	G1	S1	1B.1
Dudleya viscida sticky dudleya	PDCRA040T0	None	None	G2	S2	1B.2
Elanus leucurus white-tailed kite	ABNKC06010	None	None	G5	S3S4	FP
Empidonax traillii extimus southwestern willow flycatcher	ABPAE33043	Endangered	Endangered	G5T2	S1	
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eremophila alpestris actia California horned lark	ABPAT02011	None	None	G5T4Q	S4	WL
Eryngium aristulatum var. parishii San Diego button-celery	PDAPI0Z042	Endangered	Endangered	G5T1	S1	1B.1
Eryngium pendletonense Pendleton button-celery	PDAPI0Z120	None	None	G1	S1	1B.1
Erysimum ammophilum sand-loving wallflower	PDBRA16010	None	None	G2	S2	1B.2
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	SSC
Eumops perotis californicus western mastiff bat	AMACD02011	None	None	G5T4	S3S4	SSC
Euphorbia misera cliff spurge	PDEUP0Q1B0	None	None	G5	S2	2B.2

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Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Ferocactus viridescens San Diego barrel cactus	PDCAC08060	None	None	G3?	S2S3	2B.1
Gila orcuttii arroyo chub	AFCJB13120	None	None	G2	S2	SSC
Harpagonella palmeri Palmer's grapplinghook	PDBOR0H010	None	None	G4	S3	4.2
Horkelia cuneata var. puberula mesa horkelia	PDROS0W045	None	None	G4T1	S1	1B.1
Horkelia truncata Ramona horkelia	PDROS0W0G0	None	None	G3	S3	1B.3
Imperata brevifolia California satintail	PMPOA3D020	None	None	G4	S3	2B.1
Isocoma menziesii var. decumbens decumbent goldenbush	PDAST57091	None	None	G3G5T2T3	S2	1B.2
Iva hayesiana San Diego marsh-elder	PDAST580A0	None	None	G3	S2	2B.2
Lasiurus blossevillii western red bat	AMACC05060	None	None	G5	S3	SSC
Lasthenia glabrata ssp. coulteri Coulter's goldfields	PDAST5L0A1	None	None	G4T2	S2	1B.1
Lepidium virginicum var. robinsonii Robinson's pepper-grass	PDBRA1M114	None	None	G5T3	S3	4.3
Leptonycteris yerbabuenae lesser long-nosed bat	AMACB03030	Endangered	None	G4	S1	
Leptosyne maritima sea dahlia	PDAST2L0L0	None	None	G2	S1S2	2B.2
Lilium parryi lemon lily	PMLIL1A0J0	None	None	G3	S3	1B.2
Monardella hypoleuca ssp. intermedia intermediate monardella	PDLAM180A4	None	None	G4T2?	S2?	1B.3
Monardella macrantha ssp. hallii Hall's monardella	PDLAM180E1	None	None	G5T3	S3	1B.3
Myosurus minimus ssp. apus little mousetail	PDRAN0H031	None	None	G5T2Q	S2	3.1
Myotis yumanensis Yuma myotis	AMACC01020	None	None	G5	S4	
Nama stenocarpa mud nama	PDHYD0A0H0	None	None	G4G5	S1S2	2B.2
Navarretia fossalis spreading navarretia	PDPLM0C080	Threatened	None	G2	S2	1B.1
Navarretia prostrata prostrate vernal pool navarretia	PDPLM0C0Q0	None	None	G2	S2	1B.1

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Nemacaulis denudata var. denudata coast woolly-heads	PDPGN0G011	None	None	G3G4T2	S2	1B.2
Nemacaulis denudata var. gracilis slender cottonheads	PDPGN0G012	None	None	G3G4T3?	S2	2B.2
Neotoma lepida intermedia San Diego desert woodrat	AMAFF08041	None	None	G5T3T4	S3S4	SSC
Nolina cismontana chaparral nolina	PMAGA080E0	None	None	G3	S3	1B.2
Nyctinomops femorosaccus pocketed free-tailed bat	AMACD04010	None	None	G4	S3	SSC
Oncorhynchus mykiss irideus pop. 10 steelhead - southern California DPS	AFCHA0209J	Endangered	None	G5T1Q	S1	
Passerculus sandwichensis beldingi Belding's savannah sparrow	ABPBX99015	None	Endangered	G5T3	S3	
Pentachaeta aurea ssp. allenii Allen's pentachaeta	PDAST6X021	None	None	G4T1	S1	1B.1
Perognathus longimembris pacificus Pacific pocket mouse	AMAFD01042	Endangered	None	G5T1	S1	SSC
Phacelia stellaris Brand's star phacelia	PDHYD0C510	None	None	G1	S1	1B.1
Phrynosoma blainvillii coast horned lizard	ARACF12100	None	None	G3G4	S3S4	SSC
Plestiodon skiltonianus interparietalis Coronado skink	ARACH01114	None	None	G5T5	S2S3	WL
Polioptila californica californica coastal California gnatcatcher	ABPBJ08081	Threatened	None	G4G5T2Q	S2	SSC
Pseudognaphalium leucocephalum white rabbit-tobacco	PDAST440C0	None	None	G4	S2	2B.2
Quercus dumosa Nuttall's scrub oak	PDFAG050D0	None	None	G3	S3	1B.1
Rallus obsoletus levipes light-footed Ridgway's rail	ABNME05014	Endangered	Endangered	G5T1T2	S1	FP
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
San Diego Mesa Hardpan Vernal Pool San Diego Mesa Hardpan Vernal Pool	CTT44321CA	None	None	G2	S2.1	
Senecio aphanactis chaparral ragwort	PDAST8H060	None	None	G3	S2	2B.2
Sidalcea neomexicana salt spring checkerbloom	PDMAL110J0	None	None	G4	S2	2B.2
Southern Coast Live Oak Riparian Forest Southern Coast Live Oak Riparian Forest	CTT61310CA	None	None	G4	S4	

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Southern Coastal Salt Marsh Southern Coastal Salt Marsh	CTT52120CA	None	None	G2	S2.1	
Southern Cottonwood Willow Riparian Forest Southern Cottonwood Willow Riparian Forest	CTT61330CA	None	None	G3	S3.2	
Southern Dune Scrub Southern Dune Scrub	CTT21330CA	None	None	G1	S1.1	
Southern Foredunes Southern Foredunes	CTT21230CA	None	None	G2	S2.1	
Southern Mixed Riparian Forest Southern Mixed Riparian Forest	CTT61340CA	None	None	G2	S2.1	
Southern Riparian Forest Southern Riparian Forest	CTT61300CA	None	None	G4	S4	
Southern Sycamore Alder Riparian Woodland Southern Sycamore Alder Riparian Woodland	CTT62400CA	None	None	G4	S4	
Spea hammondii western spadefoot	AAABF02020	None	None	G3	S3	SSC
Sternula antillarum browni California least tern	ABNNM08103	Endangered	Endangered	G4T2T3Q	S2	FP
Streptocephalus woottoni Riverside fairy shrimp	ICBRA07010	Endangered	None	G1G2	S1S2	
Suaeda esteroa estuary seablite	PDCHE0P0D0	None	None	G3	S2	1B.2
Taricha torosa Coast Range newt	AAAAF02032	None	None	G4	S4	SSC
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Tetracoccus dioicus Parry's tetracoccus	PDEUP1C010	None	None	G3?	S2	1B.2
Thamnophis hammondii two-striped gartersnake	ARADB36160	None	None	G4	S3S4	SSC
Tortula californica California screw moss	NBMUS7L090	None	None	G2G3	S2S3	1B.2
Tryonia imitator mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	G2	S2	
Valley Needlegrass Grassland Valley Needlegrass Grassland	CTT42110CA	None	None	G3	S3.1	
Verbesina dissita big-leaved crownbeard	PDAST9R050	Threatened	Threatened	G1G2	S1	1B.1
Viguiera purisimae La Purisima viguiera	PDAST9T0S0	None	None	G4	S1	2B.3
Vireo bellii pusillus least Bell's vireo	ABPBW01114	Endangered	Endangered	G5T2	S2	

Record Count: 123

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CNPS Inventory of Rare and Endangered Plants
Quads Queried: San Clemente, San Onofre Bluff, Dana Point, San Juan Capistrano, Canada Gobernadora, Sitton Peak, Margaria Peak, Las Pulgas Canyon, and Oceanside

Scientific Name	Common Name	Family	Lifeform	CRPR	GRank	SRank	CESA	FESA	Blooming Period	Habitat	Micro Habitat	Elevation Low (ft)	Elevation High (ft)
Abronia maritima	red sand-verbena	Nyctaginaceae	perennial herb	4.2	G4	S3?	None	None	Feb-Nov	Coastal dunes		0	330
Acmispon prostratus	Nuttall's acmispon	Fabaceae	annual herb	1B.1	G1G2	S1	None	None	Mar-Jun(Jul)	Coastal dunes, Coastal scrub (sandy)		0	35
Ambrosia pumila	San Diego ambrosia	Asteraceae	perennial rhizomatous herb	1B.1	G1	S1	None	FE	Apr-Oct	Chaparral, Coastal scrub, Valley and foothill grassland, Vernal pools	sandy loam or clay, often in disturbed areas, sometimes alkaline	65	1360
Aphanisma blitoides	aphanisma	Chenopodiaceae	annual herb	1B.2	G3G4	S2	None	None	Feb-Jun	Coastal bluff scrub, Coastal dunes, Coastal scrub	sandy or gravelly	0	1000
Arctostaphylos rainbowensis	Rainbow manzanita	Ericaceae	perennial evergreen shrub	1B.1	G2	S2	None	None	Dec-Mar	Chaparral		670	2200
Artemisia palmeri	San Diego sagewort	Asteraceae	perennial deciduous shrub	4.2	G3?	S3?	None	None	(Feb)May-Sep	Chaparral, Coastal scrub, Riparian forest, Riparian scrub, Riparian woodland	sandy, mesic	45	3000
Asplenium vespertinum	western spleenwort	Aspleniaceae	perennial rhizomatous herb	4.2	G4	S4	None	None	Feb-Jun	Chaparral, Cismontane woodland, Coastal scrub	rocky	590	3280
Astragalus tener var. titi	coastal dunes milk-vetch	Fabaceae	annual herb	1B.1	G2T1	S1	CE	FE	Mar-May	Coastal bluff scrub (sandy), Coastal dunes, Coastal prairie (mesic)	often vernally mesic areas	0	165
Atriplex coulteri	Coulter's saltbush	Chenopodiaceae	perennial herb	1B.2	G3	S1S2	None	None	Mar-Oct	Coastal bluff scrub, Coastal dunes, Coastal scrub, Valley and foothill grassland	alkaline or clay	5	1510
Atriplex pacifica	South Coast saltscale	Chenopodiaceae	annual herb	1B.2	G4	S2	None	None	Mar-Oct	Coastal bluff scrub, Coastal dunes, Coastal scrub, Playas		0	460
Baccharis vanessae	Encinitas baccharis	Asteraceae	perennial deciduous shrub	1B.1	G1	S1	CE	FT	Aug,Oct,Nov	Chaparral (maritime), Cismontane woodland	sandstone	195	2360
Brodiaea filifolia	thread-leaved brodiaea	Themidaceae	perennial bulbiferous herb	1B.1	G2	S2	CE	FT	Mar-Jun	Chaparral (openings), Cismontane woodland, Coastal scrub, Playas, Valley and foothill grassland, Vernal pools	often clay	80	3675
Brodiaea orcuttii	Orcutt's brodiaea	Themidaceae	perennial bulbiferous herb	1B.1	G2	S2	None	None	May-Jul	Closed-cone coniferous forest, Chaparral, Cismontane woodland, Meadows and seeps, Valley and foothill grassland, Vernal pools	mesic, clay	95	5550
Brodiaea santarosae	Santa Rosa Basalt brodiaea	Themidaceae	perennial bulbiferous herb	1B.2	G1	S1	None	None	May-Jun	Valley and foothill grassland	basaltic	1850	3430
Calochortus catalinae	Catalina mariposa lily	Liliaceae	perennial bulbiferous herb	4.2	G3G4	S3S4	None	None	(Feb)Mar-Jun	Chaparral, Cismontane woodland, Coastal scrub, Valley and foothill grassland		45	2295
Calochortus plummerae	Plummer's mariposa lily	Liliaceae	perennial bulbiferous herb	4.2	G4	S4	None	None	May-Jul	Chaparral, Cismontane woodland, Coastal scrub, Lower montane coniferous forest, Valley and foothill grassland	granitic, rocky	325	5575
Calochortus weedii var. intermedius	intermediate mariposa lily	Liliaceae	perennial bulbiferous herb	1B.2	G3G4T2	S2	None	None	May-Jul	Chaparral, Coastal scrub, Valley and foothill grassland	rocky, calcareous	340	2805
Camissoniopsis lewisii	Lewis' evening-primrose	Onagraceae	annual herb	3	G4	S4	None	None	Mar-May(Jun)	Coastal bluff scrub, Cismontane woodland, Coastal dunes, Coastal scrub, Valley and foothill grassland	sandy or clay	0	985
Caulanthus simulans	Payson's jewelflower	Brassicaceae	annual herb	4.2	G4	S4	None	None	(Feb)Mar-May(Jun)	Chaparral, Coastal scrub	sandy, granitic	295	7220
Centromadia parryi ssp. australis	southern tarplant	Asteraceae	annual herb	1B.1	G3T2	S2	None	None	May-Nov	Marshes and swamps (margins), Valley and foothill grassland (vernally mesic), Vernal pools		0	1575

CNPS Inventory of Rare and Endangered Plants
Quads Queried: San Clemente, San Onofre Bluff, Dana Point, San Juan Capistrano, Canada Gobernadora, Sitton Peak, Margaria Peak, Las Pulgas Canyon, and Oceanside

Scientific Name	Common Name	Family	Lifeform	CRPR	GRank	SRank	CESA	FESA	Blooming Period	Habitat	Micro Habitat	Elevation Low (ft)	Elevation High (ft)
Centromadia pungens ssp. laevis	smooth tarplant	Asteraceae	annual herb	1B.1	G3G4T2	S2	None	None	Apr-Sep	Chenopod scrub, Meadows and seeps, Playas, Riparian woodland, Valley and foothill grassland	alkaline	0	2100
Chaenactis glabriuscula var. orcuttiana	Orcutt's pincushion	Asteraceae	annual herb	1B.1	G5T1T2	S1	None	None	Jan-Aug	Coastal bluff scrub (sandy), Coastal dunes		0	330
Chamaebatia australis	southern mountain misery	Rosaceae	perennial evergreen shrub	4.2	G4	S4	None	None	Nov-May	Chaparral (gabbroic or metavolcanic)		980	3345
Chorizanthe leptotheca	Peninsular spineflower	Polygonaceae	annual herb	4.2	G3	S3	None	None	May-Aug	Chaparral, Coastal scrub, Lower montane coniferous forest	alluvial fan, granitic	980	6235
Chorizanthe polygonoides var. longispina	long-spined spineflower	Polygonaceae	annual herb	1B.2	G5T3	S3	None	None	Apr-Jul	Chaparral, Coastal scrub, Meadows and seeps, Valley and foothill grassland, Vernal pools	often clay	95	5020
Cistanthe maritima	seaside cistanthe	Montiaceae	annual herb	4.2	G3G4	S3	None	None	(Feb)Mar-Jun(Aug)	Coastal bluff scrub, Coastal scrub, Valley and foothill grassland	sandy	15	985
Clinopodium chandleri	San Miguel savory	Lamiaceae	perennial shrub	1B.2	G2	S2	None	None	Mar-Jul	Chaparral, Cismontane woodland, Coastal scrub, Riparian woodland, Valley and foothill grassland	Rocky, gabbroic or metavolcanic	390	3525
Comarostaphylis diversifolia ssp. diversifolia	summer holly	Ericaceae	perennial evergreen shrub	1B.2	G3T2	S2	None	None	Apr-Jun	Chaparral, Cismontane woodland		95	2590
Convolvulus simulans	small-flowered morning-glory	Convolvulaceae	annual herb	4.2	G4	S4	None	None	Mar-Jul	Chaparral (openings), Coastal scrub, Valley and foothill grassland	clay, serpentinite seeps	95	2430
Deinandra paniculata	paniculate tarplant	Asteraceae	annual herb	4.2	G4	S4	None	None	(Mar)Apr-Nov	Coastal scrub, Valley and foothill grassland, Vernal pools	usually vernally mesic, sometimes sandy	80	3085
Dichondra occidentalis	western dichondra	Convolvulaceae	perennial rhizomatous herb	4.2	G3G4	S3S4	None	None	(Jan)Mar-Jul	Chaparral, Cismontane woodland, Coastal scrub, Valley and foothill grassland		160	1640
Dudleya blochmaniae ssp. blochmaniae	Blochman's dudleya	Crassulaceae	perennial herb	1B.1	G3T2	S2	None	None	Apr-Jun	Coastal bluff scrub, Chaparral, Coastal scrub, Valley and foothill grassland	rocky, often clay or serpentinite	15	1475
Dudleya multicaulis	many-stemmed dudleya	Crassulaceae	perennial herb	1B.2	G2	S2	None	None	Apr-Jul	Chaparral, Coastal scrub, Valley and foothill grassland	often clay	45	2590
Dudleya stolonifera	Laguna Beach dudleya	Crassulaceae	perennial stoloniferous herb	1B.1	G1	S1	CT	FT	May-Jul	Chaparral, Cismontane woodland, Coastal scrub, Valley and foothill grassland	rocky	30	855
Dudleya viscida	sticky dudleya	Crassulaceae	perennial herb	1B.2	G2	S2	None	None	May-Jun	Coastal bluff scrub, Chaparral, Cismontane woodland, Coastal scrub	rocky	30	1805
Eryngium aristulatum var. parishii	San Diego button-celery	Apiaceae	annual / perennial herb	1B.1	G5T1	S1	CE	FE	Apr-Jun	Coastal scrub, Valley and foothill grassland, Vernal pools	mesic	65	2035
Eryngium pendletonense	Pendleton button-celery	Apiaceae	perennial herb	1B.1	G1	S1	None	None	Apr-Jun(Jul)	Coastal bluff scrub, Valley and foothill grassland, Vernal pools	clay, vernally mesic	45	360
Erysimum ammophilum	sand-loving wallflower	Brassicaceae	perennial herb	1B.2	G2	S2	None	None	Feb-Jun	Chaparral (maritime), Coastal dunes, Coastal scrub	sandy, openings	0	195
Erythranthe diffusa	Palomar monkeyflower	Phrymaceae	annual herb	4.3	G4	S3	None	None	Apr-Jun	Chaparral, Lower montane coniferous forest	sandy or gravelly	4000	6005
Euphorbia misera	cliff spurge	Euphorbiaceae	perennial shrub	2B.2	G5	S2	None	None	Dec-Aug(Oct)	Coastal bluff scrub, Coastal scrub, Mojavean desert scrub	rocky	30	1640

CNPS Inventory of Rare and Endangered Plants
Quads Queried: San Clemente, San Onofre Bluff, Dana Point, San Juan Capistrano, Canada Gobernadora, Sitton Peak, Margaris Peak, Las Pulgas Canyon, and Oceanside

Scientific Name	Common Name	Family	Lifeform	CRPR	GRank	SRank	CESA	FESA	Blooming Period	Habitat	Micro Habitat	Elevation Low (ft)	Elevation High (ft)
Ferocactus viridescens	San Diego barrel cactus	Cactaceae	perennial stem succulent	2B.1	G3?	S2S3	None	None	May-Jun	Chaparral, Coastal scrub, Valley and foothill grassland, Vernal pools		5	1475
Harpagonella palmeri	Palmer's grapplinghook	Boraginaceae	annual herb	4.2	G4	S3	None	None	Mar-May	Chaparral, Coastal scrub, Valley and foothill grassland	Clay; open grassy areas within shrubland	65	3135
Holocarpha virgata ssp. elongata	graceful tarplant	Asteraceae	annual herb	4.2	G5T3	S3	None	None	May-Nov	Chaparral, Cismontane woodland, Coastal scrub, Valley and foothill grassland		195	3610
Hordeum intercedens	vernal barley	Poaceae	annual herb	3.2	G3G4	S3S4	None	None	Mar-Jun	Coastal dunes, Coastal scrub, Valley and foothill grassland (saline flats and depressions), Vernal pools		15	3280
Horkelia cuneata var. puberula	mesa horkelia	Rosaceae	perennial herb	1B.1	G4T1	S1	None	None	Feb-Jul(Sep)	Chaparral (maritime), Cismontane woodland, Coastal scrub	sandy or gravelly	225	2655
Horkelia truncata	Ramona horkelia	Rosaceae	perennial herb	1B.3	G3	S3	None	None	May-Jun	Chaparral, Cismontane woodland	clay, gabbroic	1310	4265
Imperata brevifolia	California satintail	Poaceae	perennial rhizomatous herb	2B.1	G4	S3	None	None	Sep-May	Chaparral, Coastal scrub, Mojavean desert scrub, Meadows and seeps (often alkali), Riparian scrub	mesic	0	3985
Isocoma menziesii var. decumbens	decumbent goldenbush	Asteraceae	perennial shrub	1B.2	G3G5T2T3	S2	None	None	Apr-Nov	Chaparral, Coastal scrub (sandy, often in disturbed areas)		30	445
Iva hayesiana	San Diego marsh-elder	Asteraceae	perennial herb	2B.2	G3	S2	None	None	Apr-Oct	Marshes and swamps, Playas		30	1640
Juglans californica	Southern California black walnut	Juglandaceae	perennial deciduous tree	4.2	G3	S3	None	None	Mar-Aug	Chaparral, Cismontane woodland, Coastal scrub, Riparian woodland	alluvial	160	2955
Juncus acutus ssp. leopoldii	southwestern spiny rush	Juncaceae	perennial rhizomatous herb	4.2	G5T5	S4	None	None	(Mar)May-Jun	Coastal dunes (mesic), Meadows and seeps (alkaline seeps), Marshes and swamps (coastal salt)		5	2955
Lasthenia glabrata ssp. coulteri	Coulter's goldfields	Asteraceae	annual herb	1B.1	G4T2	S2	None	None	Feb-Jun	Marshes and swamps (coastal salt), Playas, Vernal pools		0	4005
Lepidium virginicum var. robinsonii	Robinson's pepper-grass	Brassicaceae	annual herb	4.3	G5T3	S3	None	None	Jan-Jul	Chaparral, Coastal scrub		0	2905
Leptosyne maritima	sea dahlia	Asteraceae	perennial herb	2B.2	G2	S1	None	None	Mar-May	Coastal bluff scrub, Coastal scrub		15	490
Lilium humboldtii ssp. ocellatum	ocellated Humboldt lily	Liliaceae	perennial bulbiferous herb	4.2	G4T4?	S4?	None	None	Mar-Jul(Aug)	Chaparral, Cismontane woodland, Coastal scrub, Lower montane coniferous forest, Riparian woodland	openings	95	5905
Lilium parryi	lemon lily	Liliaceae	perennial bulbiferous herb	1B.2	G3	S3	None	None	Jul-Aug	Lower montane coniferous forest, Meadows and seeps, Riparian forest, Upper montane coniferous forest	mesic	4000	9005
Lycium brevipes var. hassei	Santa Catalina Island desert-thorn	Solanaceae	perennial deciduous shrub	3.1	G5T1Q	S1	None	None	Jun(Aug)	Coastal bluff scrub, Coastal scrub		210	985
Lycium californicum	California box-thorn	Solanaceae	perennial shrub	4.2	G4	S4	None	None	(Dec)Mar,Jun,Jul,Aug	Coastal bluff scrub, Coastal scrub		15	490
Malacothrix saxatilis var. saxatilis	cliff malacothrix	Asteraceae	perennial rhizomatous herb	4.2	G5T4	S4	None	None	Mar-Sep	Coastal bluff scrub, Coastal scrub		5	655

CNPS Inventory of Rare and Endangered Plants
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Scientific Name	Common Name	Family	Lifeform	CRPR	GRank	SRank	CESA	FESA	Blooming Period	Habitat	Micro Habitat	Elevation Low (ft)	Elevation High (ft)
Microseris douglasii ssp. platycarpha	small-flowered microseris	Asteraceae	annual herb	4.2	G4T4	S4	None	None	Mar-May	Cismontane woodland, Coastal scrub, Valley and foothill grassland, Vernal pools	clay	45	3510
Monardella hypoleuca ssp. intermedia	intermediate monardella	Lamiaceae	perennial rhizomatous herb	1B.3	G4T2?	S2?	None	None	Apr-Sep	Chaparral, Cismontane woodland, Lower montane coniferous forest (sometimes)	Usually understory	1310	4100
Monardella hypoleuca ssp. lanata	felt-leaved monardella	Lamiaceae	perennial rhizomatous herb	1B.2	G4T3	S3	None	None	Jun-Aug	Chaparral, Cismontane woodland		980	5165
Monardella macrantha ssp. hallii	Hall's monardella	Lamiaceae	perennial rhizomatous herb	1B.3	G5T3	S3	None	None	Jun-Oct	Broadleafed upland forest, Chaparral, Cismontane woodland, Lower montane coniferous forest, Valley and foothill grassland		2395	7200
Myosurus minimus ssp. apus	little mousetail	Ranunculaceae	annual herb	3.1	G5T2Q	S2	None	None	Mar-Jun	Valley and foothill grassland, Vernal pools (alkaline)		65	2100
Nama stenocarpa	mud nama	Namaceae	annual / perennial herb	2B.2	G4G5	S1S2	None	None	Jan-Jul	Marshes and swamps (lake margins, riverbanks)		15	1640
Navarretia fossalis	spreading navarretia	Polemoniaceae	annual herb	1B.1	G2	S2	None	FT	Apr-Jun	Chenopod scrub, Marshes and swamps (assorted shallow freshwater), Playas, Vernal pools		95	2150
Navarretia prostrata	prostrate vernal pool navarretia	Polemoniaceae	annual herb	1B.1	G2	S2	None	None	Apr-Jul	Coastal scrub, Meadows and seeps, Valley and foothill grassland (alkaline), Vernal pools	Mesic	5	3970
Nemacaulis denudata var. denudata	coast woolly-heads	Polygonaceae	annual herb	1B.2	G3G4T2	S2	None	None	Apr-Sep	Coastal dunes		0	330
Nemacaulis denudata var. gracilis	slender cottonheads	Polygonaceae	annual herb	2B.2	G3G4T3?	S2	None	None	(Mar)Apr-May	Coastal dunes, Desert dunes, Sonoran desert scrub		-160	1310
Nolina cismontana	chaparral nolina	Ruscaceae	perennial evergreen shrub	1B.2	G3	S3	None	None	(Mar)May-Jul	Chaparral, Coastal scrub	sandstone or gabbro	455	4185
Pentachaeta aurea ssp. allenii	Allen's pentachaeta	Asteraceae	annual herb	1B.1	G4T1	S1	None	None	Mar-Jun	Coastal scrub (openings), Valley and foothill grassland		245	1705
Phacelia ramosissima var. austrolitoralis	south coast branching phacelia	Hydrophyllaceae	perennial herb	3.2	G5?T3	S3	None	None	Mar-Aug	Chaparral, Coastal dunes, Coastal scrub, Marshes and swamps (coastal salt)	sandy, sometimes rocky	15	985
Phacelia stellaris	Brand's star phacelia	Hydrophyllaceae	annual herb	1B.1	G1	S1	None	None	Mar-Jun	Coastal dunes, Coastal scrub		0	1310
Pickeringia montana var. tomentosa	woolly chaparral-pea	Fabaceae	evergreen shrub	4.3	G5T3T4	S3S4	None	None	May-Aug	Chaparral	Gabbroic, granitic, clay	0	5575
Pinus torreyana ssp. torreyana	Torrey pine	Pinaceae	perennial evergreen tree	1B.2	G1T1	S1	None	None		Closed-cone coniferous forest, Chaparral	Sandstone	95	525
Piperia cooperi	chaparral rein orchid	Orchidaceae	perennial herb	4.2	G3	S3	None	None	Mar-Jun	Chaparral, Cismontane woodland, Valley and foothill grassland		45	5200
Polygala cornuta var. fishiae	Fish's milkwort	Polygalaceae	perennial deciduous shrub	4.3	G5T4	S4	None	None	May-Aug	Chaparral, Cismontane woodland, Riparian woodland		325	3280
Pseudognaphalium leucocephalum	white rabbit-tobacco	Asteraceae	perennial herb	2B.2	G4	S2	None	None	(Jul)Aug-Nov(Dec)	Chaparral, Cismontane woodland, Coastal scrub, Riparian woodland	sandy, gravelly	0	6890

CNPS Inventory of Rare and Endangered Plants
Quads Queried: San Clemente, San Onofre Bluff, Dana Point, San Juan Capistrano, Canada Gobernadora, Sitton Peak, Margaria Peak, Las Pulgas Canyon, and Oceanside

Scientific Name	Common Name	Family	Lifeform	CRPR	GRank	SRank	CESA	FESA	Blooming Period	Habitat	Micro Habitat	Elevation Low (ft)	Elevation High (ft)
Quercus dumosa	Nuttall's scrub oak	Fagaceae	perennial evergreen shrub	1B.1	G3	S3	None	None	Feb-Apr(May-Aug)	Closed-cone coniferous forest, Chaparral, Coastal scrub	sandy, clay loam	45	1310
Quercus engelmannii	Engelmann oak	Fagaceae	perennial deciduous tree	4.2	G3	S3	None	None	Mar-Jun	Chaparral, Cismontane woodland, Riparian woodland, Valley and foothill grassland		160	4265
Romneya coulteri	Coulter's matilija poppy	Papaveraceae	perennial rhizomatous herb	4.2	G4	S4	None	None	Mar-Jul(Aug)	Chaparral, Coastal scrub	Often in burns	65	3935
Saltugilia caruifolia	caraway-leaved woodland-gilia	Polemoniaceae	annual herb	4.3	G4	S4	None	None	May-Aug	Chaparral, Lower montane coniferous forest	Sandy, openings	2755	7545
Selaginella cinerascens	ashy spike-moss	Selaginellaceae	perennial rhizomatous herb	4.1	G3G4	S3	None	None		Chaparral, Coastal scrub		65	2100
Senecio aphanactis	chaparral ragwort	Asteraceae	annual herb	2B.2	G3	S2	None	None	Jan-Apr(May)	Chaparral, Cismontane woodland, Coastal scrub	sometimes alkaline	45	2625
Sidalcea neomexicana	salt spring checkerbloom	Malvaceae	perennial herb	2B.2	G4	S2	None	None	Mar-Jun	Chaparral, Coastal scrub, Lower montane coniferous forest, Mojavean desert scrub, Playas	alkaline, mesic	45	5020
Suaeda esteroa	estuary seablite	Chenopodiaceae	perennial herb	1B.2	G3	S2	None	None	(May)Jul-Oct(Jan)	Marshes and swamps (coastal salt)		0	15
Suaeda taxifolia	woolly seablite	Chenopodiaceae	perennial evergreen shrub	4.2	G	S4	None	None	Jan-Dec	Coastal bluff scrub, Coastal dunes, Marshes and swamps (margins of coastal salt)		0	165
Tetracoccus dioicus	Parry's tetracoccus	Picrodendraceae	perennial deciduous shrub	1B.2	G3?	S2	None	None	Apr-May	Chaparral, Coastal scrub		540	3280
Tortula californica	California screw-moss	Pottiaceae	moss	1B.2	G2G3	S2S3	None	None		Chenopod scrub, Valley and foothill grassland	sandy, soil	30	4790
Verbesina dissita	big-leaved crownbeard	Asteraceae	perennial herb	1B.1	G1G2	S1	CT	FT	(Mar)Apr-Jul	Chaparral (maritime), Coastal scrub		145	675
Viguiera laciniata	San Diego County viguiera	Asteraceae	perennial shrub	4.3	G4	S4	None	None	Feb-Jun(Aug)	Chaparral, Coastal scrub		195	2460
Viguiera purisimae	La Purisima viguiera	Asteraceae	shrub	2B.3	G4	S1	None	None	Apr-Sep	Coastal bluff scrub, Chaparral		1195	1395
Duplicate species also on CNDDB.													

EFH Data Notice: Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional Fishery Management Councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Northwest Regional Office
Southwest Regional Office
Pacific GIS Mapping Tool
Alaska Regional Office

Query Results

Map Scale = 1:36,112
Degrees, Minutes, Seconds: Latitude = 33º22'12" N, Longitude = 117º33'38" E
Decimal Degrees: Latitude = 33.37, Longitude = -117.56

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

EFH

Show	Link	Data Caveats	Species/Management Unit	Life stage(s) Found at Location	Management Council	FMP
			Finfish and Market Squid	ALL	Pacific	Null
			Krill - Thysanoessa Spinifera	ALL	Pacific	Null
			Krill - Euphausia Pacifica	ALL	Pacific	Null
			Other Krill Species	ALL	Pacific	Null
			Coastal Pelagic Species	ALL	Pacific	Null
			Groundfish	ALL	Pacific	Groundfish

Pacific Salmon EFH

No Pacific Salmon Essential Fish Habitat (EFH) were identified at the report location.

HAPCs

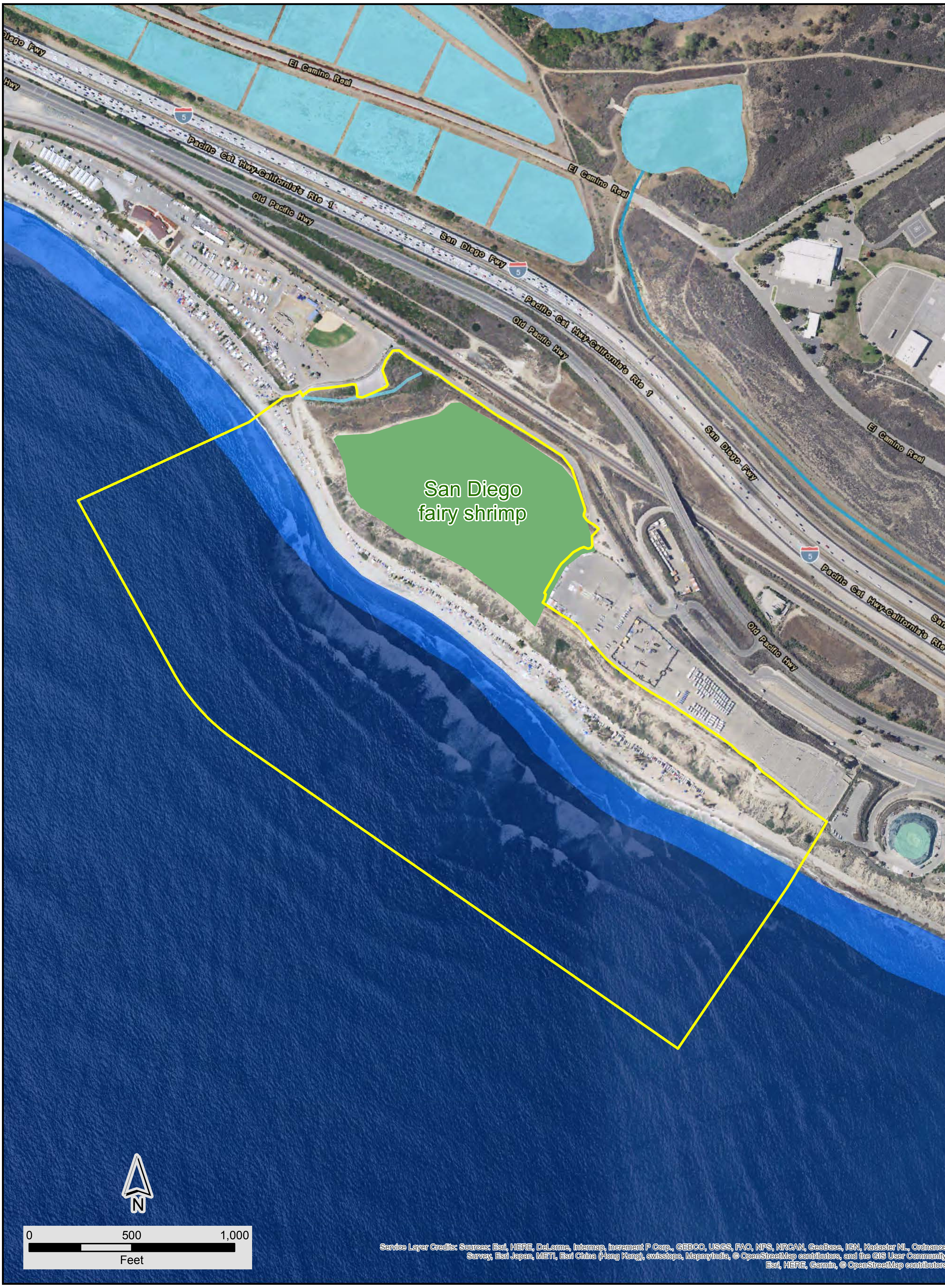
No Habitat Areas of Particular Concern (HAPC) were identified at the report location.

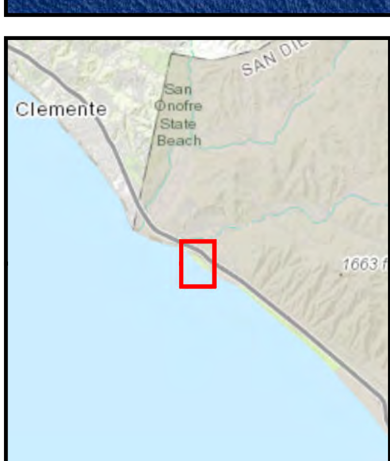
EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data.
****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
Pacific Coastal Pelagic Species, Jack Mackerel, Pacific (Chub) Mackerel, Pacific Sardine, Northern Anchovy - Central Subpopulation, Northern Anchovy - Northern Subpopulation, **Pacific Highly Migratory Species,** Bigeye Thresher Shark - North Pacific, Bluefin Tuna - Pacific, Dolphinfish (Dorado or Mahimahi) - Pacific, Pelagic Thresher Shark - North Pacific, Swordfish - North Pacific, **West Coast Salmon,** All species and stocks





Legend

- Survey Area
- USFWS Critical Habitat Polygons

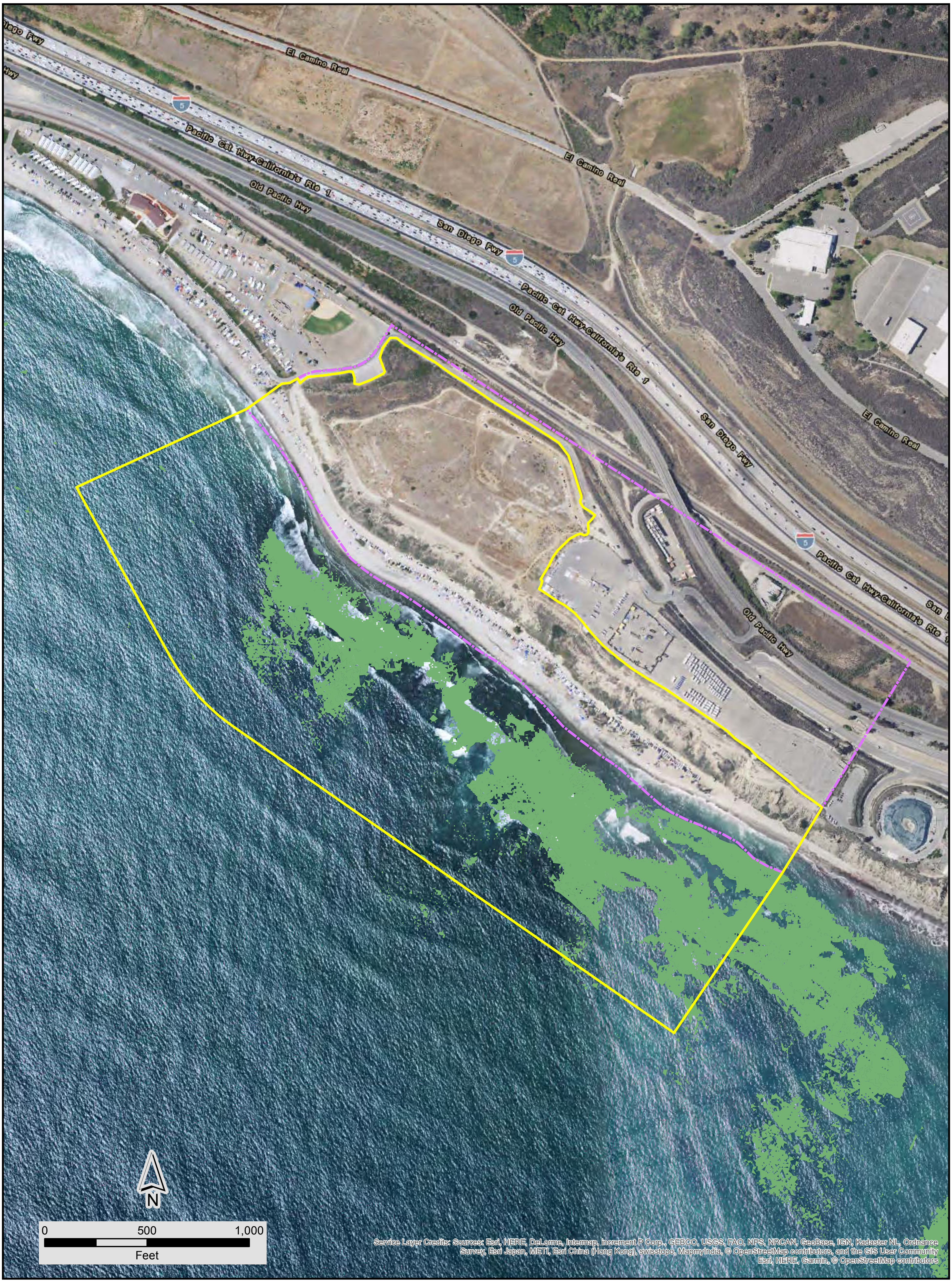
Mapped NWI Wetland Type

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Riverine
- Freshwater Pond

San Onofre USFWS NWI & Critical Habitat Occurrences

CHAMBERS GROUP

Name: 21075 BIO USFWS CH NWI.Mxd
Print Date: 5/22/2018, Author: esimmons



Legend

- Survey Area
- San Onofre State Beach
- Kelp Canopy (CDFW 2012)

San Onofre CDFW Aerial Kelp Survey Results 2012

CHAMBERS GROUP

Name: 21075 BIO Kelp 2012.Mxd
Print Date: 5/22/2018, Author: msimmons

APPENDIX B: EMERGENCY REVETMENT PERMIT

CALIFORNIA COASTAL COMMISSION
SAN DIEGO COAST DISTRICT OFFICE
7575 METROPOLITAN DR, SUITE 103
SAN DIEGO, CALIFORNIA 92108
PH (619) 767-2370 FAX (619) 767-2384
WWW.COASTAL.CA.GOV

EMERGENCY PERMIT

Issue Date: February 16, 2017
Emergency Permit No. **G-6-17-0002**

APPLICANT:
California State Parks, Orange Coast District, Attn: Julie Tobin
3030 Avenida del Presidente, San Clemente, CA 92672

LOCATION OF EMERGENCY WORK:
SAN ONOFRE STATE BEACH, SURF BEACH DAY USE AREA
5200 S. PACIFIC COAST HIGHWAY, SAN DIEGO COUNTY, CA (APN: 101-520-10)

WORK AUTHORIZED:
Temporary placement until November 1, 2017, of 900 linear feet of rip rap and geotextile fabric consisting of 8 ton toe stone fronting two layers of 5-6 ton base stone and 3-4 ton stone atop it, at an approximately 1:1-1.5:1 incline, on an escarpment on the seaward side of the existing unpaved parking lot access road and a portion of the upcoast day use parking area to protect these facilities from further damage from storm events. The authorized work is depicted and described on the revised plans submitted January 13, 2017 (see Exhibit A attached).

PERMIT RATIONALE:
This letter constitutes approval of the emergency work you or your representative has requested to be done at the location listed above. I understand from your information and our site inspection that an unexpected occurrence in the form of erosion requires immediate action to prevent or mitigate loss or damage to life, health, property or essential public services. 14 Cal. Admin. Code Section 13009. The access road is considerably narrowed and the parking area is in danger of undermining as a result of erosion from recent high swell and high water levels. The Executive Director of the Coastal Commission hereby finds that:

(a) An emergency exists which requires action more quickly than permitted by the procedures for administrative or ordinary permits and the development can and will be completed within 30 days unless otherwise specified by the terms of this permit;
(b) Public comment on the proposed emergency action has been reviewed if time allows;
(c) As conditioned, the work proposed would be consistent with the requirements of the California Coastal Act of 1976.

The work is hereby approved, subject to conditions listed on the attached pages.

Sincerely,
John Ainsworth
Executive Director

By: Karl Schwing
Deputy Director, San Diego Coast District

Enclosures: 1) Acceptance Form; 2) Regular Permit Application Form (available for download at https://documents.coastal.ca.gov/assets/cdp/CDP-ApplicationForm-sd.pdf)

EMERGENCY PERMIT

CONDITIONS OF APPROVAL:

1. The enclosed Emergency Permit Acceptance form must be signed by the PROPERTY OWNER and returned to our office within 15 days.

2. Only that work specifically described in this permit and for the specific property listed above is authorized. Any additional work requires separate authorization from the Executive Director.

3. The work authorized by this permit must be completed within 90 days of the date of issuance of this permit (i.e. May 17, 2017). This deadline may be extended by the Executive Director, in writing, for good cause. The applicant shall document existing conditions at the site prior to undertaking work authorized by this permit.

4. The work authorized by this emergency permit is temporary and only authorized for a limited time period. All rock placed under this emergency permit action must be completely removed by **November 1, 2017**, unless the date is extended prior to November 1, 2017, by Commission action pursuant to Condition No. 5. Persistence of any temporary measure approved via this Emergency Permit on the site past November 1, 2017, that is not authorized by the Commission will constitute unpermitted development, and, therefore, a violation of the Coastal Act. Commission enforcement staff will consider appropriate action to address the persistence of any temporary measures past the deadline for removal. Such action may include assessment of monetary penalties under Coastal Act Section 30821 for violations of the public access provisions of the Coastal Act.

5. No rock placed pursuant to this emergency Coastal Development Permit may remain on the beach beyond November 1, 2017, unless a regular Coastal Development Permit (CDP) is received through the California Coastal Commission. The permittee may apply for a regular coastal development permit to extend, on an interim basis, the time period authorized for retention of the rock, or portions thereof, until a long-term plan is implemented. If the property owner applies for a CDP to keep the rock revetment, or any portion thereof, in place, such application shall include a new date certain for removal, unless retention of rock in some form is authorized through a regular CDP taking into consideration alternatives to the rock revetment as a long-term solution.

6. Alternatives Analysis for Long-Term Solution. As part of the application for a regular Coastal Development Permit, the applicant shall include an analysis of alternatives to the rock revetment to provide for the long term protection and provision of public improvements, coastal access, public opportunities for coastal recreation, and coastal resources including beach and shoreline habitat, taking into consideration future sea level rise. Measures to be considered should include but not be limited to phased implementation of beach nourishment, soft protection, managed retreat, smaller parking lot area, use of flexible pavers or other paving surfaces that may be more adaptable to beach erosion, narrow-profile armoring, such as a vertical wall, focused or small-scale armoring, and mixed or hybrid options and a time line for implementation of the long-term solution(s).

EMERGENCY PERMIT

7. Any additional work requires separate authorization from the Executive Director. In exercising this permit, the permittee agrees to hold the California Coastal Commission harmless from any liabilities for damage to public or private properties or personal injury that may result from the project.

8. The proposed rock revetment shall be no more than 900 ft. long, and shall extend no more seaward of the existing toe of the escarpment, including revetment toe stone with key, than as shown in the cross-section dated and submitted on January 13, 2017. The proposed rock revetment shall be constructed between a 1.1-1.5 (h) to 1.0 (v) slope and no greater.

9. Public Access. The rocks shall be placed as far landward as possible and the permittee shall to the maximum extent practicable, minimize the size of the revetment to maintain the largest portion of beach possible. To the extent possible, rocks shall be placed in a manner to allow pedestrian access over the rock revetment to the beach.

10. Methods for erosion control shall be maintained around the project site during construction.

11. Machinery, vehicles, and construction materials not essential for emergency work are prohibited at all times in beach areas.

12. Construction staging activities and equipment and materials storage areas shall not be located in vegetation areas, wetland areas or in any other environmentally sensitive habitat area. Use of public parking areas for construction staging or materials storage shall be limited to the smallest area possible. The storage or stockpiling of soil, silt, other organic or earthen materials, or any materials and chemicals related to the construction, shall not occur where such materials/chemicals could pass into coastal waters. Refueling of construction equipment shall occur off-site or within a designated fueling area that can contain fueling-related spills. Any spills of construction equipment fluids or other hazardous materials shall be immediately contained on-site and disposed of in an environmentally safe manner as soon as possible.

13. Monitoring and Maintenance Plan. The permittee shall be responsible for monitoring and maintaining the rock revetment for as long as the rock reinforcement remains in place. The permittee, at a minimum, shall provide for monthly or more frequent observations of the structure that examine the full extent of the revetment for deficiencies, including but not limited to rock that has detached from the revetment or moved seaward of the permitted footprint, a drop in the back shore elevation of the revetment, exposure of the underlying fabric layer, etc. and if deficiencies are identified, the permittee will arrange an inspection by a licensed engineer.

14. The revetment observations shall be documented with survey reports that include photographs of all sections of the structure, time and location of the observations, name and title of the person making the observations and shall be submitted to the Executive Director as part of the regular coastal development permit. As required under Special Condition 13, Engineers Inspection reports shall be prepared and submitted to the Executive Director as part of the regular coastal development permit application. These inspection reports shall provide information on and photographs from the date(s) of the inspection(s), the name and

EMERGENCY PERMIT

qualifications of the State representative or engineer performing the inspection, photographs of the revetment taken at the time of inspection, additional photographs of any structural damage or rock migration, photographs depicting beach width and elevation as it relates to the face of the rock revetment, and an overall assessment of the continued integrity of the revetment. If the inspection identifies any areas where the revetment has been damaged, the report shall identify repair and maintenance alternatives to remedy the damage. If any rock is retrieved in accordance with Condition No. 15, the location of the retrieval and the volume of rock shall be included in the inspection report.

15. In the event that any sections of rock have migrated or been dislodged, the permittee shall retrieve any errant rock and either place it back on the structure or remove it from the project site.

16. Public Rights. The approval of this permit shall not constitute a waiver of any public rights that exist or may exist on the property. The permittee shall not use this permit as evidence of a waiver of any public rights that may exist on the property.

17. This permit does not obviate the need to obtain necessary authorizations and/or permits from other agencies, including but not limited to the California State Lands Commission, California Department of Fish and Wildlife, U.S. Fish and Wildlife, National Marine Fisheries Service, and/or the U.S. Army Corps of Engineers.

As noted in Condition No. 4, the emergency work carried out under this permit is considered to be ***TEMPORARY*** work done in an emergency situation. If the property owner wishes to have the emergency work become a permanent development, a Coastal Permit must be obtained. A regular permit would be subject to all of the provisions of the California Coastal Act and may be conditioned accordingly. These conditions may include provisions for public access (such as an offer to dedicate and easement) and/or a requirement that a deed restriction be placed on the property assuming liability for damages incurred from storm waves.

If you have any questions about the provisioning of this emergency permit, please call the Commission at the address and telephone number listed on the first page.

CALIFORNIA COASTAL COMMISSION
SAN DIEGO AREA
7575 METROPOLITAN DRIVE, SUITE 103
SAN DIEGO, CA 92108-4421
(619) 767-2370

EMERGENCY PERMIT ACCEPTANCE FORM

TO: CALIFORNIA COASTAL COMMISSION
SAN DIEGO COAST AREA
7575 METROPOLITAN DRIVE, SUITE 103
SAN DIEGO, CA 92108-4402
(619) 767-2370

RE: **Emergency Permit No. G-6-17-0002**

INSTRUCTIONS: After reading the attached Emergency Permit, please sign this form and return to the San Diego Coast Area Office within 15 working days from the permit's date.

I hereby understand all of the conditions of the emergency permit being issued to me and agree to abide by them.

I also understand that a regular Coastal Permit is necessary to permanently authorize the emergency work. I agree to apply for a regular Coastal Permit within 60 days of the date of the emergency permit (i.e., by April 17, 2017).

T. Lewis
Signature of authorized agent

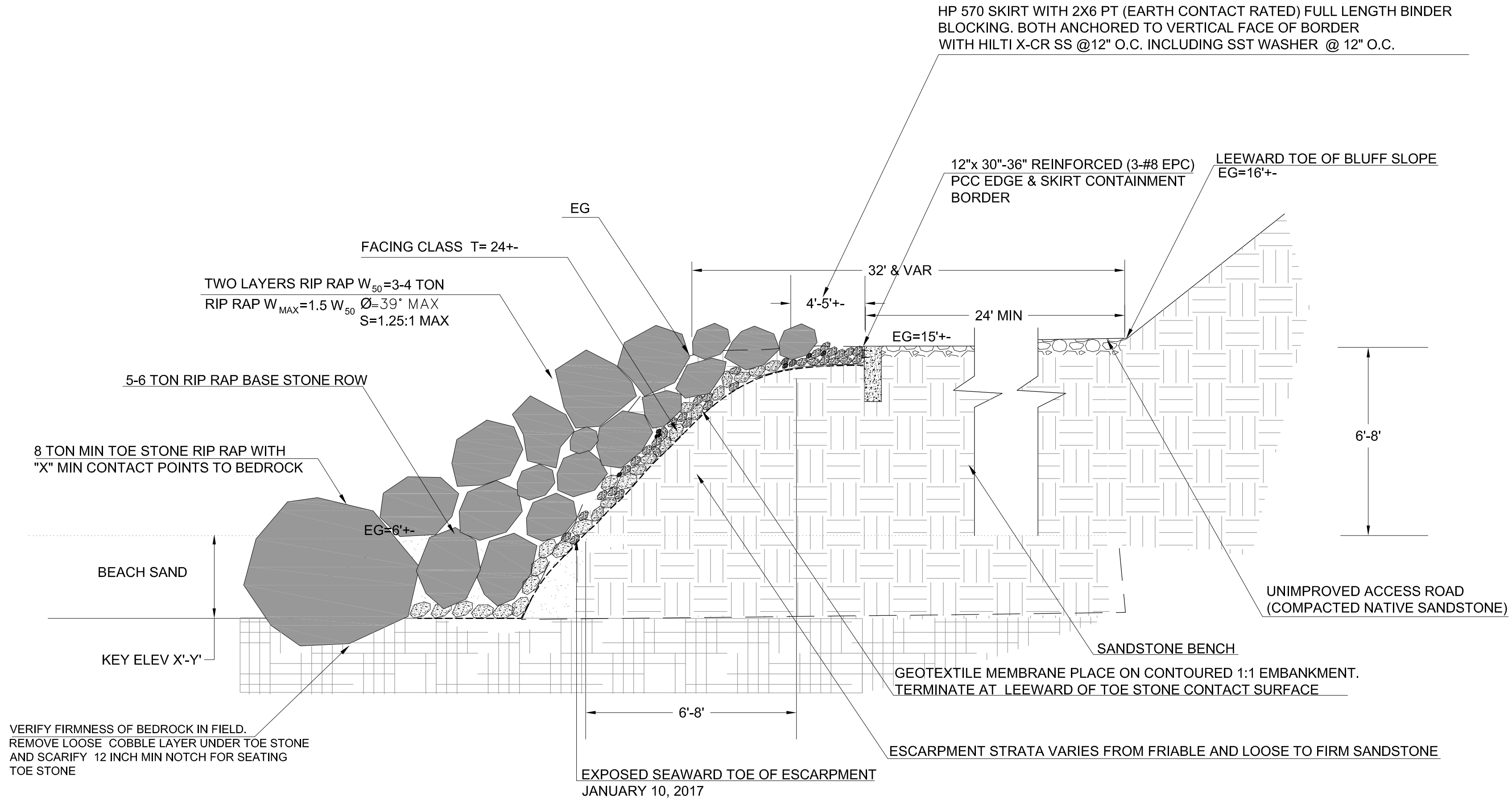
Todd Lewis
Name

3030 Avenida del Presidente
Address

San Clemente, CA 92672

02/17/2017
Date of Signing

ACQUISITION &
DEVELOPMENT DIVISION
One Capitol Mall
Sacramento, CA
95814-3229



MATERIAL QUANTITIES

8 to 10 TON STONE	_____	TONS
$\frac{1}{2}$ to 6 TON STONE	_____	TONS
FACING CLASS BACKING	_____	TONS

TYPICAL SECTION

NTS

DESIGNED:	
DRAWN:	R.ROBINSON
CHECKED:	
DATE:	1-13-2017

	REVISIONS	DATE

SAN ONOFRE STATE BEACH
SURF BEACH ACCESS ROAD

EMERGENCY REPAIR

EXHIBIT A

APPLICATION NO.

G-6-17-0002

Elevation Plan

California Coastal Commission

EXHIBIT B

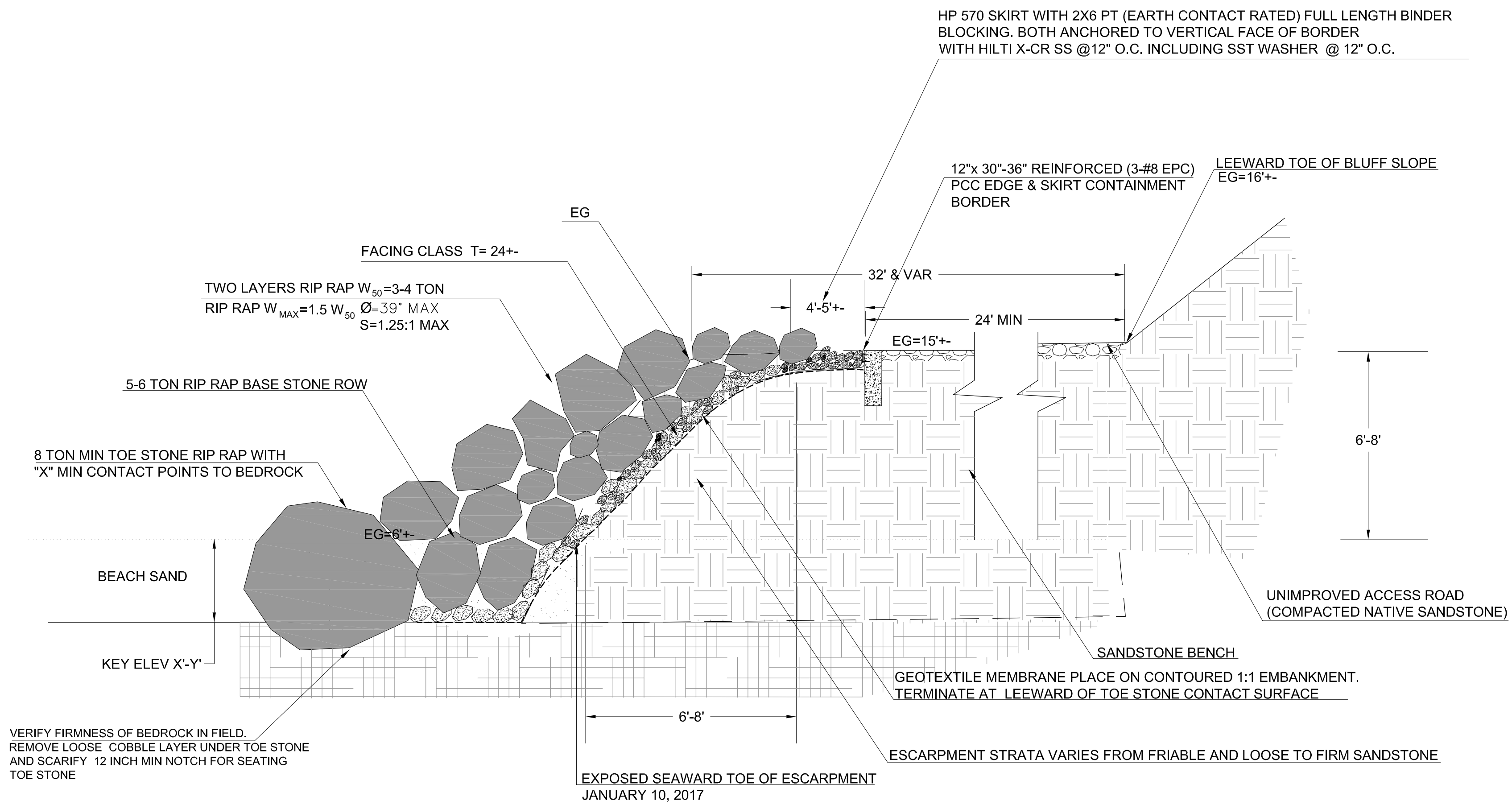
APPLICATION NO.

G-6-17-0002

Project Site

California Coastal Commission

APPENDIX C: EMERGENCY REVETMENT CONSTRUCTION DRAWINGS



MATERIAL QUANTITIES

8 to 10 TON STONE _____ TONS

$\frac{1}{2}$ to 6 TON STONE _____ TONS

FACING CLASS BACKING _____ TONS

TYPICAL SECTION

NTS

CALIFORNIA STATE PARKS SINCE 1864

ACQUISITION & DEVELOPMENT DIVISION
One Capitol Mall
Sacramento, CA
95814-3229

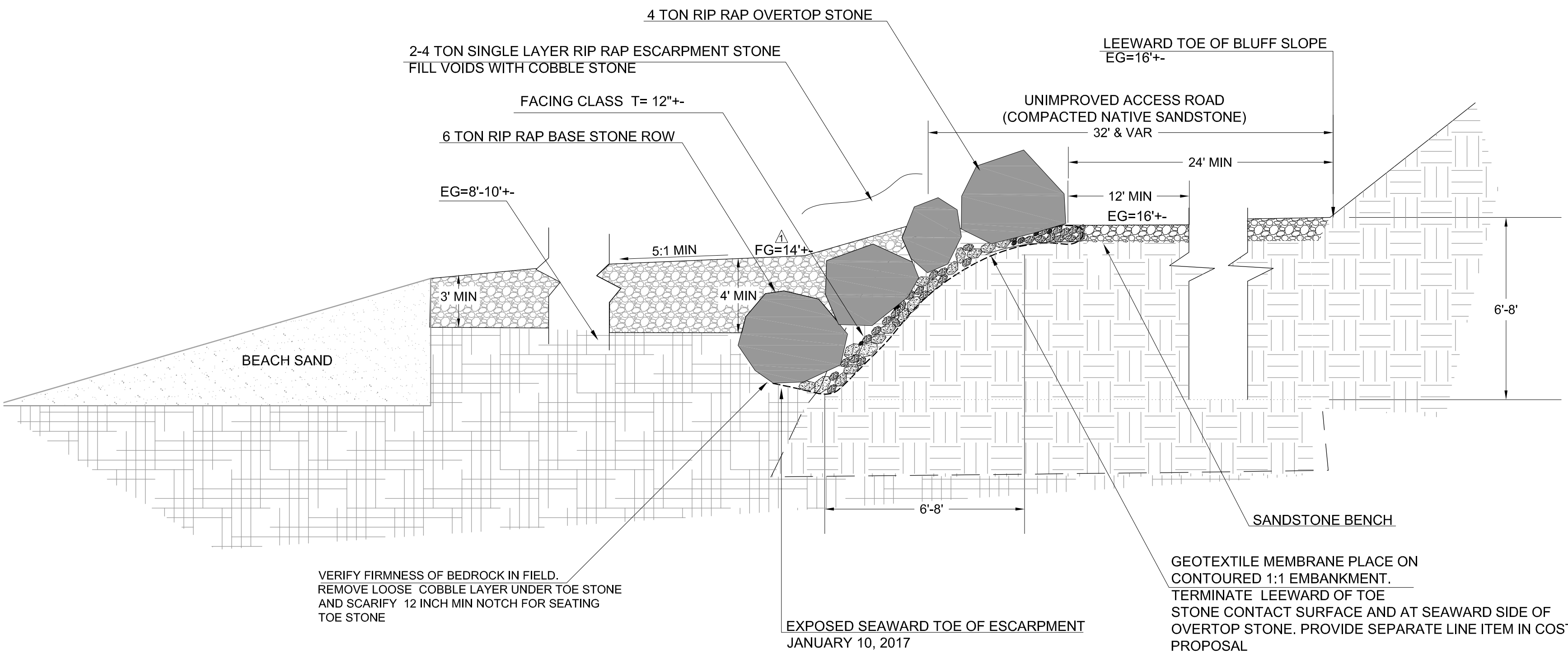
DESIGNED:
DRAWN: R.ROBINSON
CHECKED:
DATE: 1-13-2017

	REVISIONS	DATE
1	TITLE CHANGE	3/8/17

SAN ONOFRE STATE BEACH
SURF BEACH ACCESS ROAD

EMERGENCY REPAIR
OPTION #1 (revision 1)

SHEET NO.
C-2.1
1 OF 2



MATERIAL QUANTITIES

2 to 6 TON STONE _____ TONS

FACING CLASS BACKING _____ TONS

6"-12" MEDIUM @ 50% PASSING COBBLE _____ TONS
(MAY USE LOOSE NATIVE COBBLE COLLETED FROM BASE OF BLUFF
IMPORTED SHOULD MATCH NATIVE COBBLE AS CLOSE AS POSSIBLE)

TYPICAL SECTION

NTS

CALIFORNIA STATE PARKS SINCE 1864

ACQUISITION &
DEVELOPMENT DIVISION
One Capitol Mall
Sacramento, CA
95814-3229

DESIGNED:
DRAWN: R.ROBINSON
CHECKED:
DATE: 3-7-2017

	REVISIONS	DATE
1	REVISE COBBLE FG	3-9-17

SAN ONOFRE STATE BEACH
SURF BEACH ACCESS ROAD

EMERGENCY REPAIR
OPTION 2

SHEET NO.
C-2.2
2 OF 2

APPENDIX D: HISTORICAL SHORELINE AERIAL IMAGERY

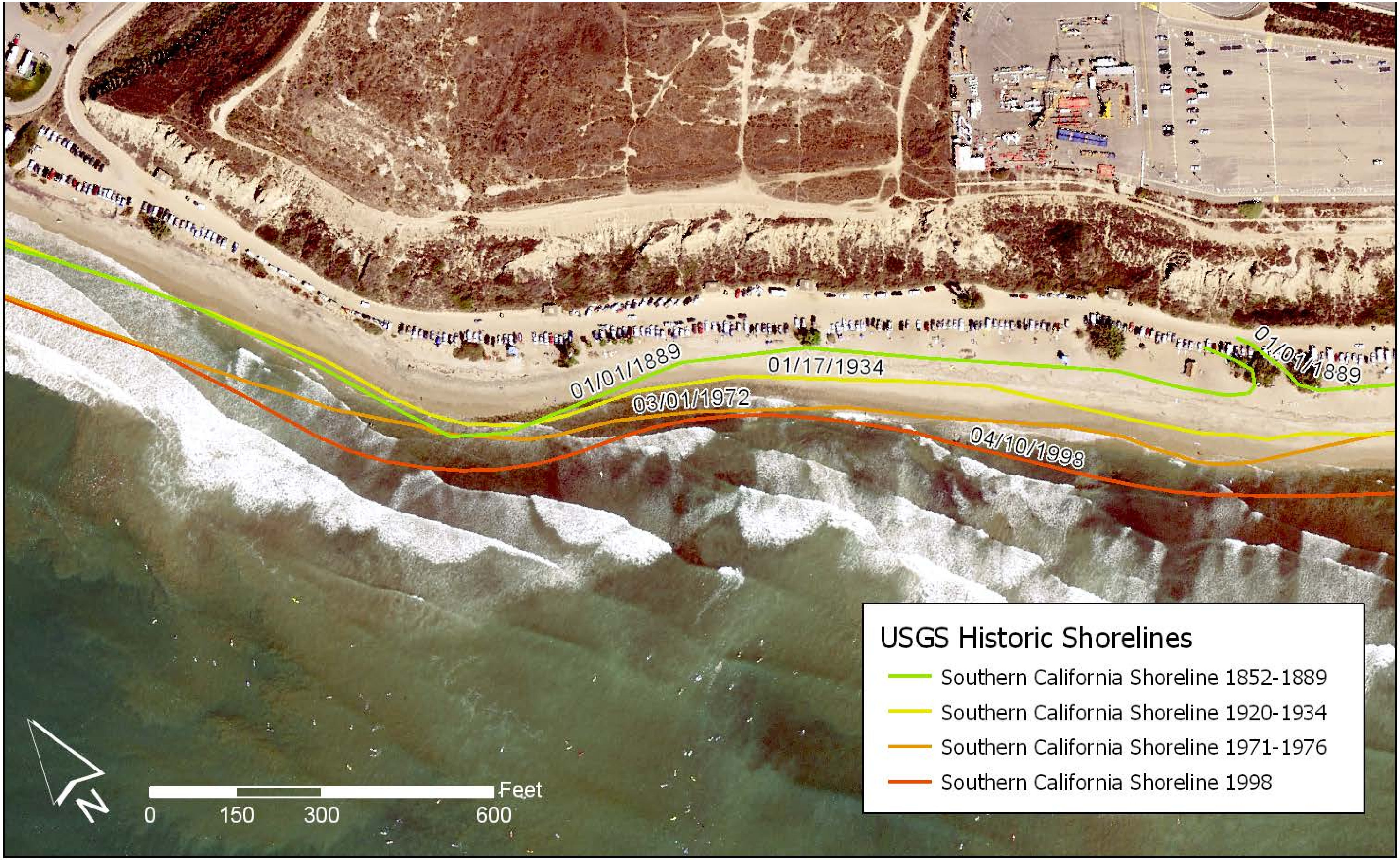
February, 1932


Aerial Photo from Special Research Collections, UCSB Library, University of California Santa Barbara
May, 1938


Aerial Photo from Special Research Collections, UCSB Library, University of California Santa Barbara
March, 1953


Aerial Photo from Special Research Collections, UCSB Library, University of California Santa Barbara
May, 1960


Aerial Photo from Special Research Collections, UCSB Library, University
Gullies filled sometime between 1960 and 1965 as indicated by aerial imagery. Material from SONGS is a likely source due to timeframe and location. Major SONGS construction was from 1964-1984. Approximately 2.9 million cubic yards of material placed on the shoreline in front of the power station.
February 1965



Background Aerial: 2010

SAN ONOFRE BEACH STUDY

by

Reinhard E. Flick

Jerome R. Wanetick

Center for Coastal Studies
University of California, San Diego
Scripps Institution of Oceanography
La Jolla, CA 92093

October 1989

SIO Reference Series #89-20

Date of Photo: June 28, 1964
Location: Edison 38+00 South,
Looking Upcoast
Photograph from Files of
Marine Advisors, Inc.

Figure 4. Photograph taken 28 June 1964 near the southern end of the SONGS property and looking north. Note construction equipment in background. Note extensive cobble field and wave cut notch in bottom of cliff face.

Date of Photo: June 28, 1964
Location: Edison 38+00 South,
Looking Downcoast
Photograph from Files of
Marine Advisors, Inc.

Figure 5. Photograph taken 28 June 1964 at same location as Figure 3, but looking south.

Figure 6. Photograph taken 13 July 1964 at same location as Figures 3 and 4, and looking south. Note thin veneer of sand that has covered the cobbles since 28 June 1964. Note high tide reaches base of cliff, as evidenced by kelp and debris line.

Figure 7. Photograph showing construction of north wall of Unit 1 laydown pad, taken on 4 June 1964 from Station "A".

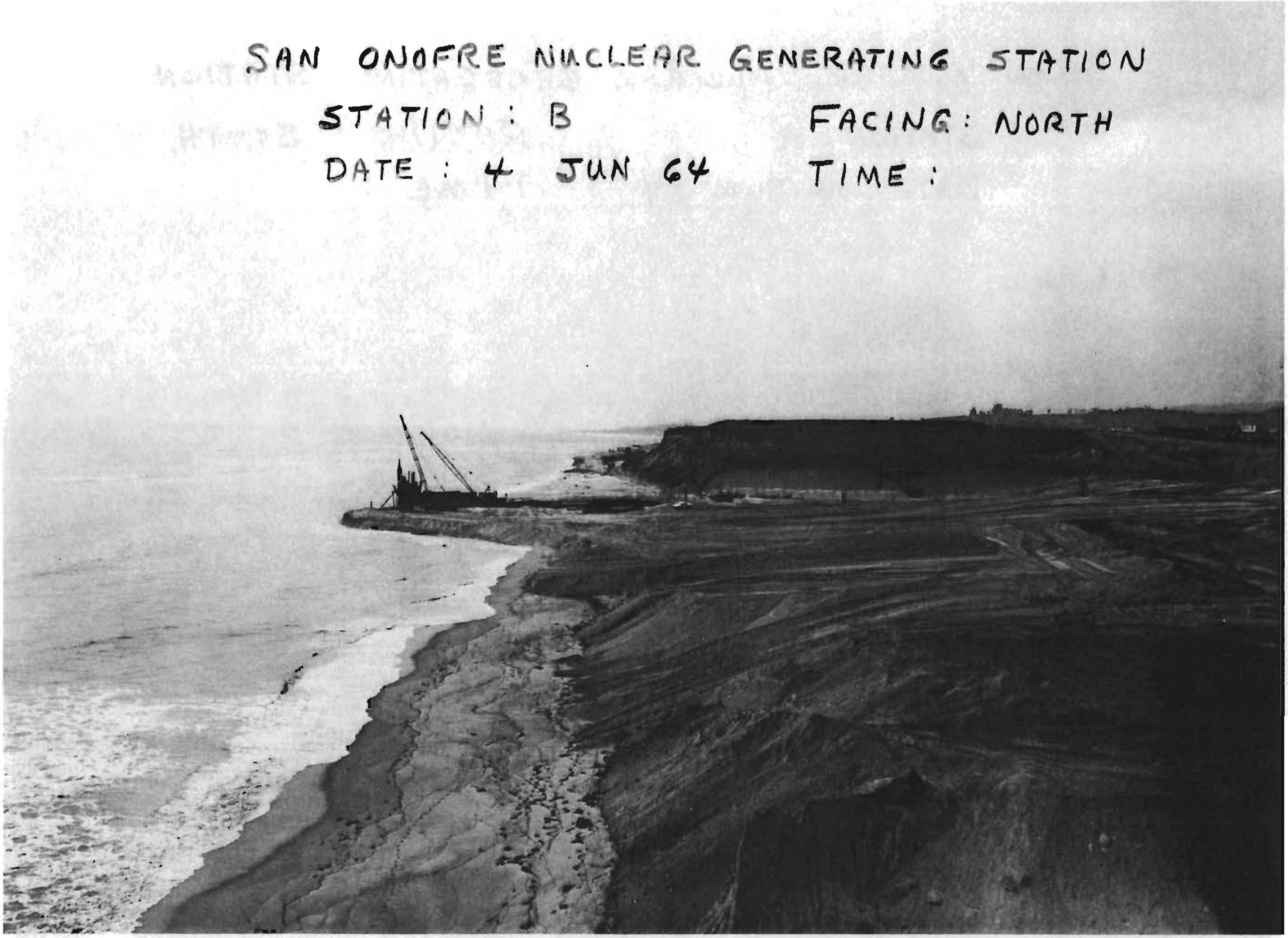


Figure 8. Photograph similar to Figure 6, but looking north from Station "B". Note the relatively narrow beach to the north of the construction activity. Also note the contact line between lower San Mateo sand formation and overlying terrace deposits in the exposed cliff cut.

Figure 9. Photograph similar to Figure 7, but taken 17 June 1964 when west portion of laydown pad was well underway.

Figure 10. Photograph showing construction of Unit 1 laydown pad taken on 24 June 1964 from Station "A". Note sand spoil on north (foreground) side of sheetpile from continued excavations, in contrast to Figure 6.

Date of Photo: Jan. 30, 1965
Location: Edison 1+00 South,
Looking Downcoast
Photograph from Files of
Marine Advisors, Inc.

Figure 11. Photograph looking south toward Unit 1 laydown pad taken 30 January 1965. Note existence of trestle used to dredge for and lay cooling pipes.

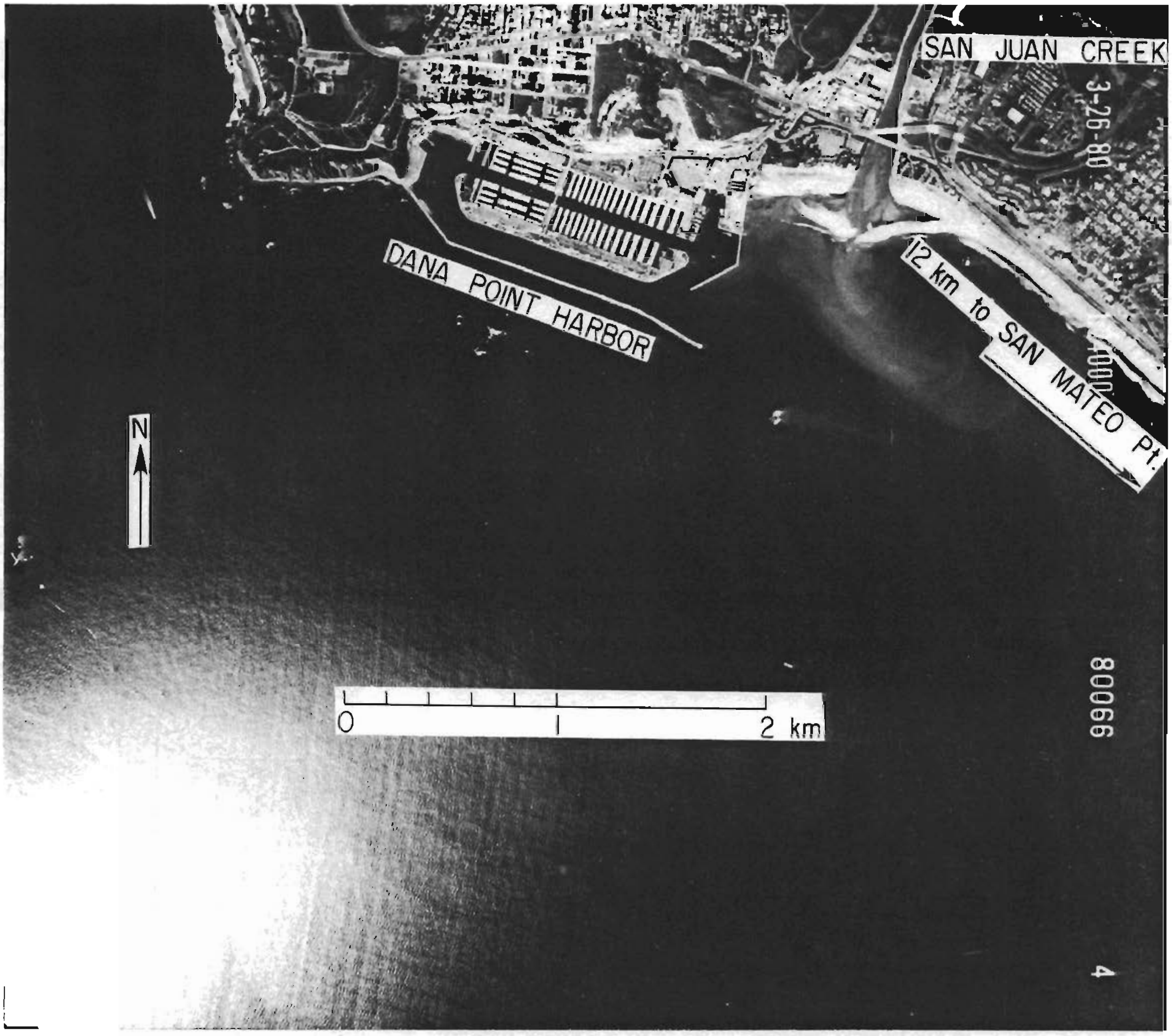


Figure 14. Aerial photograph of San Juan Creek and Dana Point area taken 26 March 1980, after severe flooding hit Southern California. Note the ebb tidal sand delta and pulsating south-bound sediment plume at the river mouth.

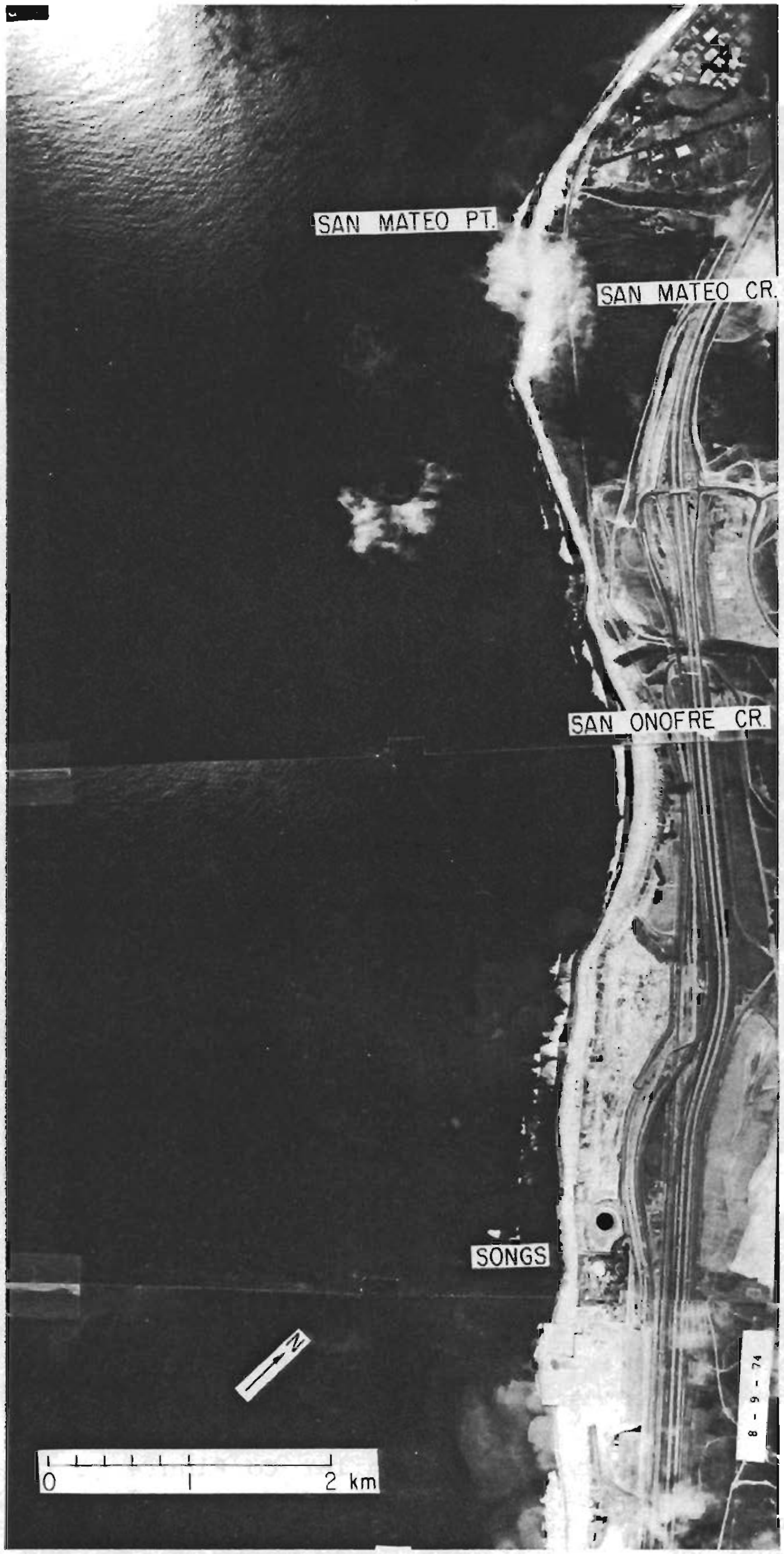


Figure 15. Aerial photograph of the reach between San Mateo Pt. and SONGS taken 9 August 1974, about 5 months after Units 2 and 3 construction began. This was a period of drought and the river mouths are closed by littoral transport. Note the indented coastline at the mouth of San Mateo Creek.

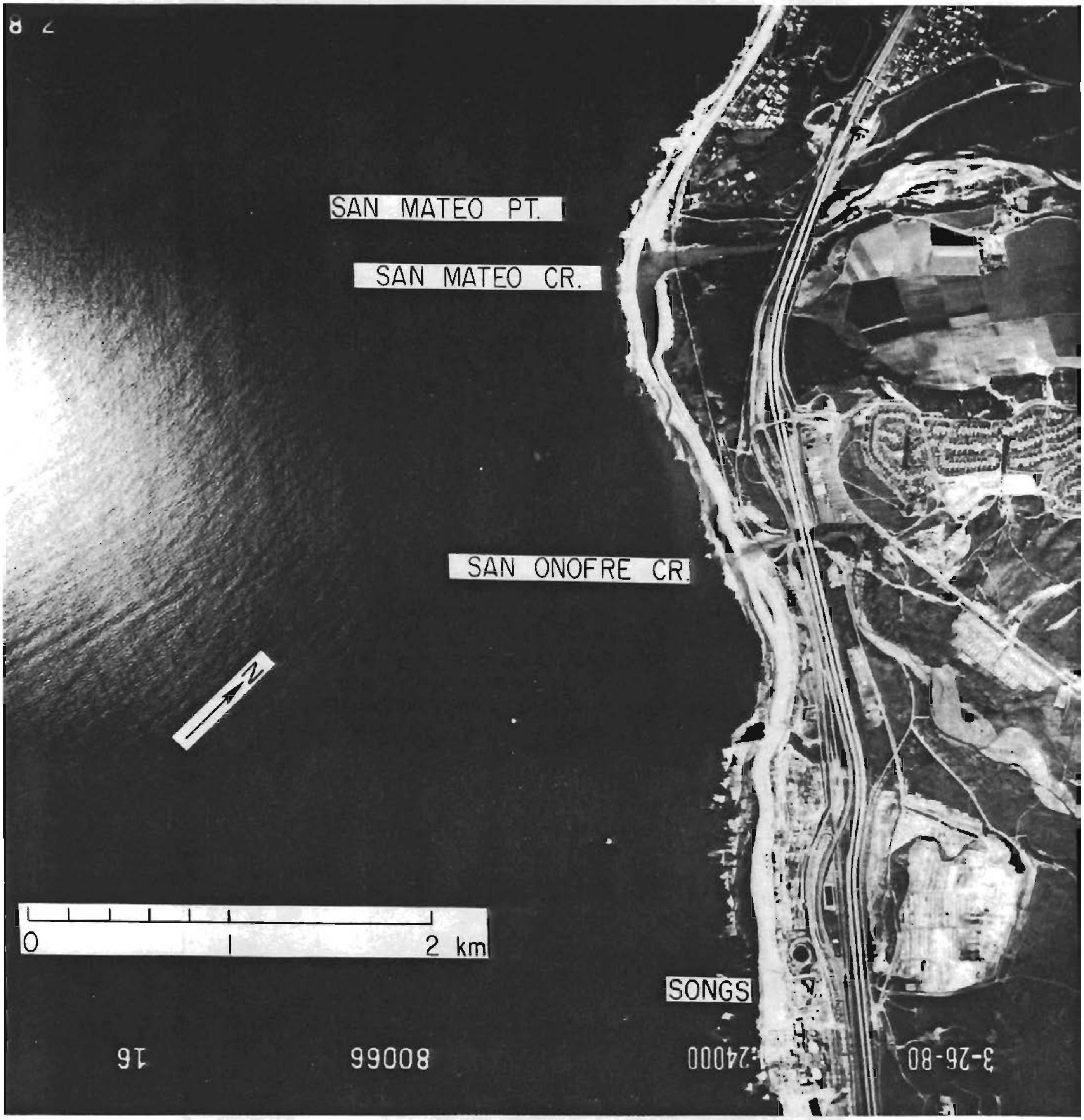


Figure 16. Aerial photograph similar to Figure 15 taken 26 March 1980, after substantial flooding occurred all over Southern California. Note the substantial sand deltas at both San Mateo and San Onofre Creeks. San Mateo Pt. is now convex, in contrast to Figure 15. Sand is now bypassing the laydown pad (bottom of picture).

Figure 18. Aerial photograph of cliff excavation early in Units 2 and 3 construction phase, 17 May 1974.

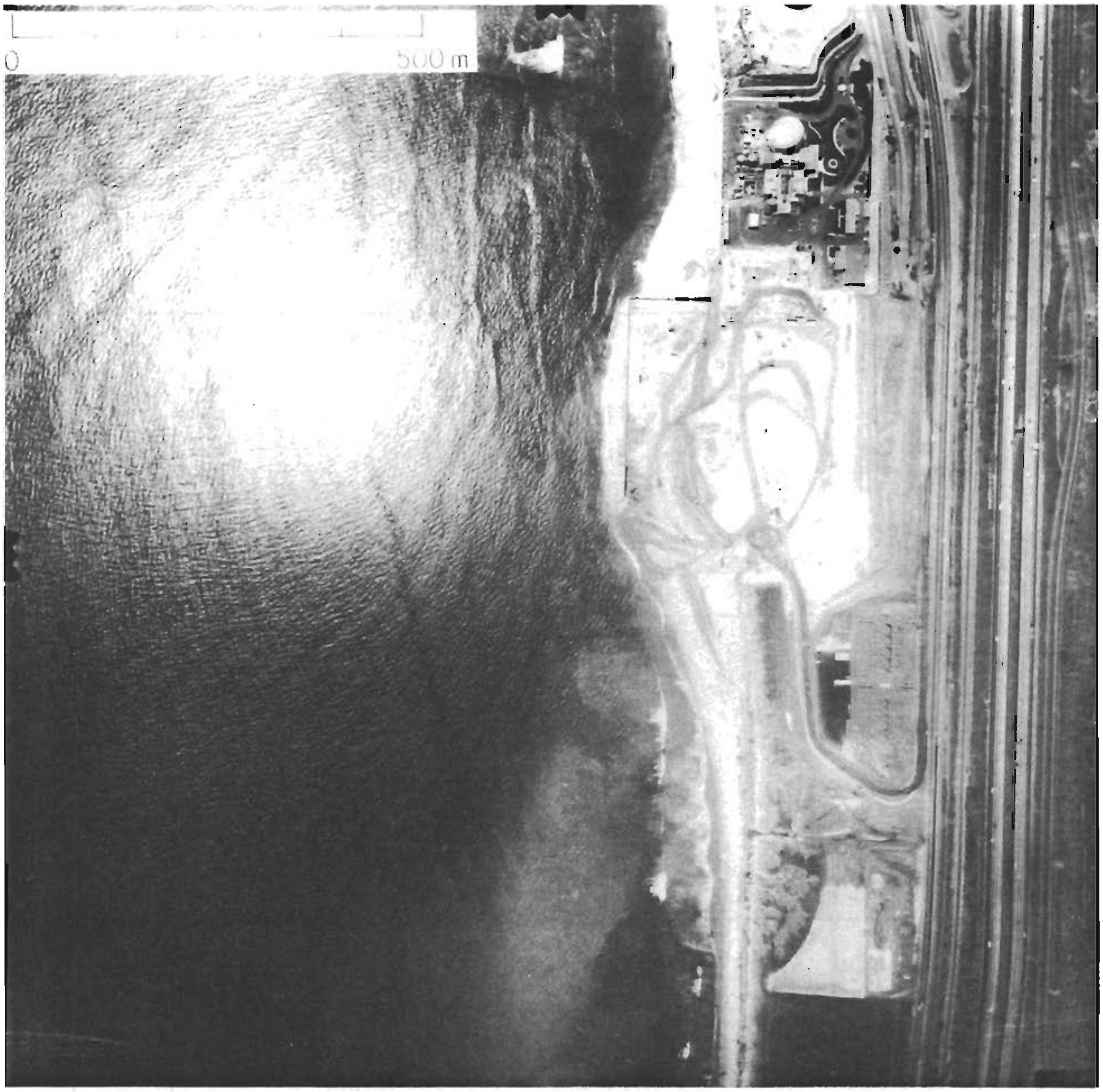


Figure 19. Aerial photograph taken 3 July 1974 and showing Units 2 and 3 laydown pad nearing completion.

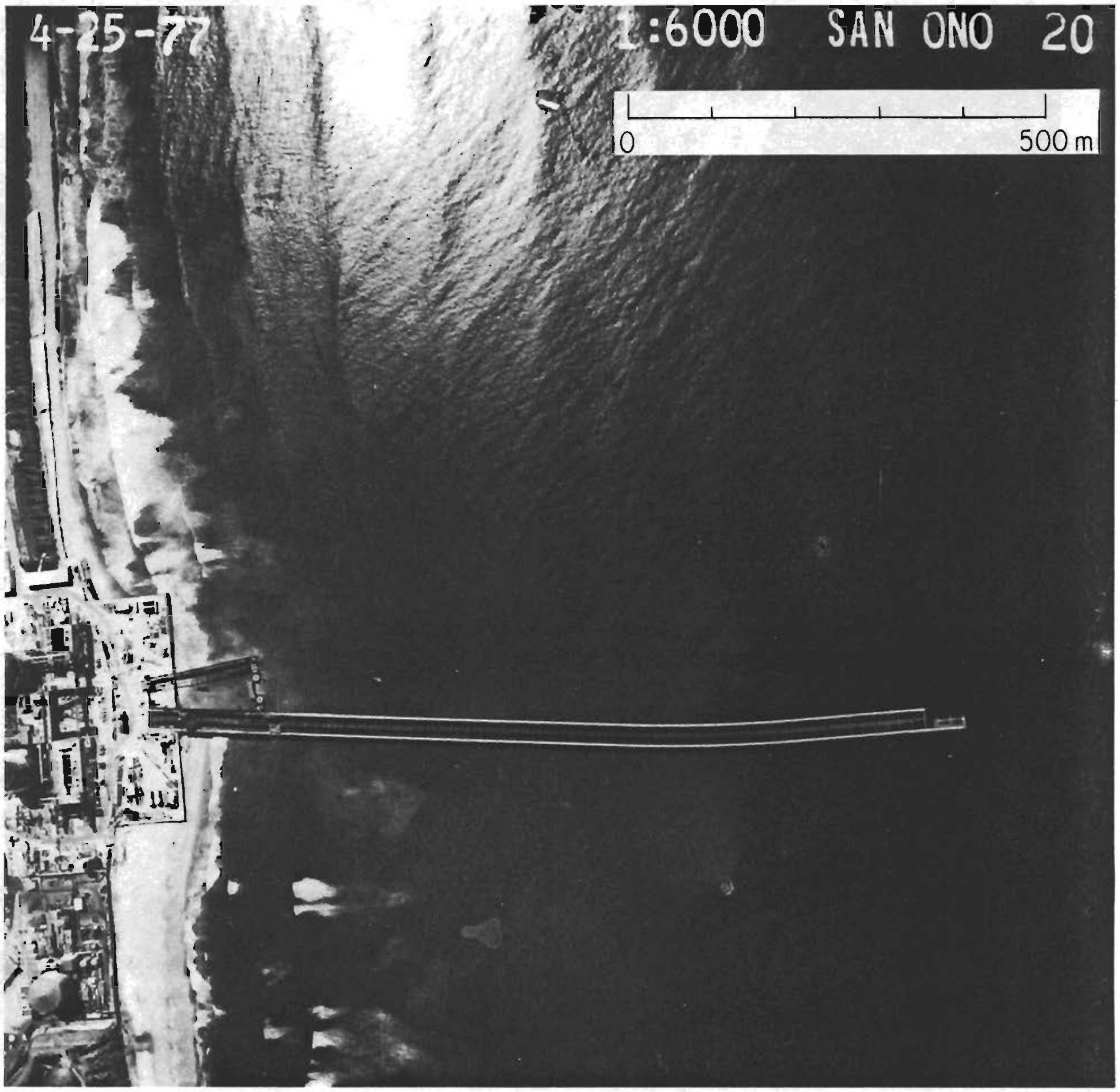


Figure 21. Aerial photograph of beach trestles used to lay Units 2 and 3 cooling pipes. Photo taken 25 April 1977. Note widened fillet beach upcoast of (below) laydown pad beginning to bypass the structure.

Figure 22. Aerial photograph of reach from San Onofre Creek to south of SONGS taken 7 February 1980. Note beach in front of laydown pad suggesting active sand bypassing at this time which limited upcoast beach width as well as downcoast erosion.

Figure 23. Aerial photograph taken 21 March 1986, about one year after removal of Units 2 and 3 laydown pad.

Figure 24. Aerial photograph taken 25 January 1988. Note much reduced beach width in front of Units 2 and 3 seawall. Contrast this with Figure 23.

May 1994

1994 2006 2018

June 2002

1994 2006 2018

March 2003

1994 2006 2018

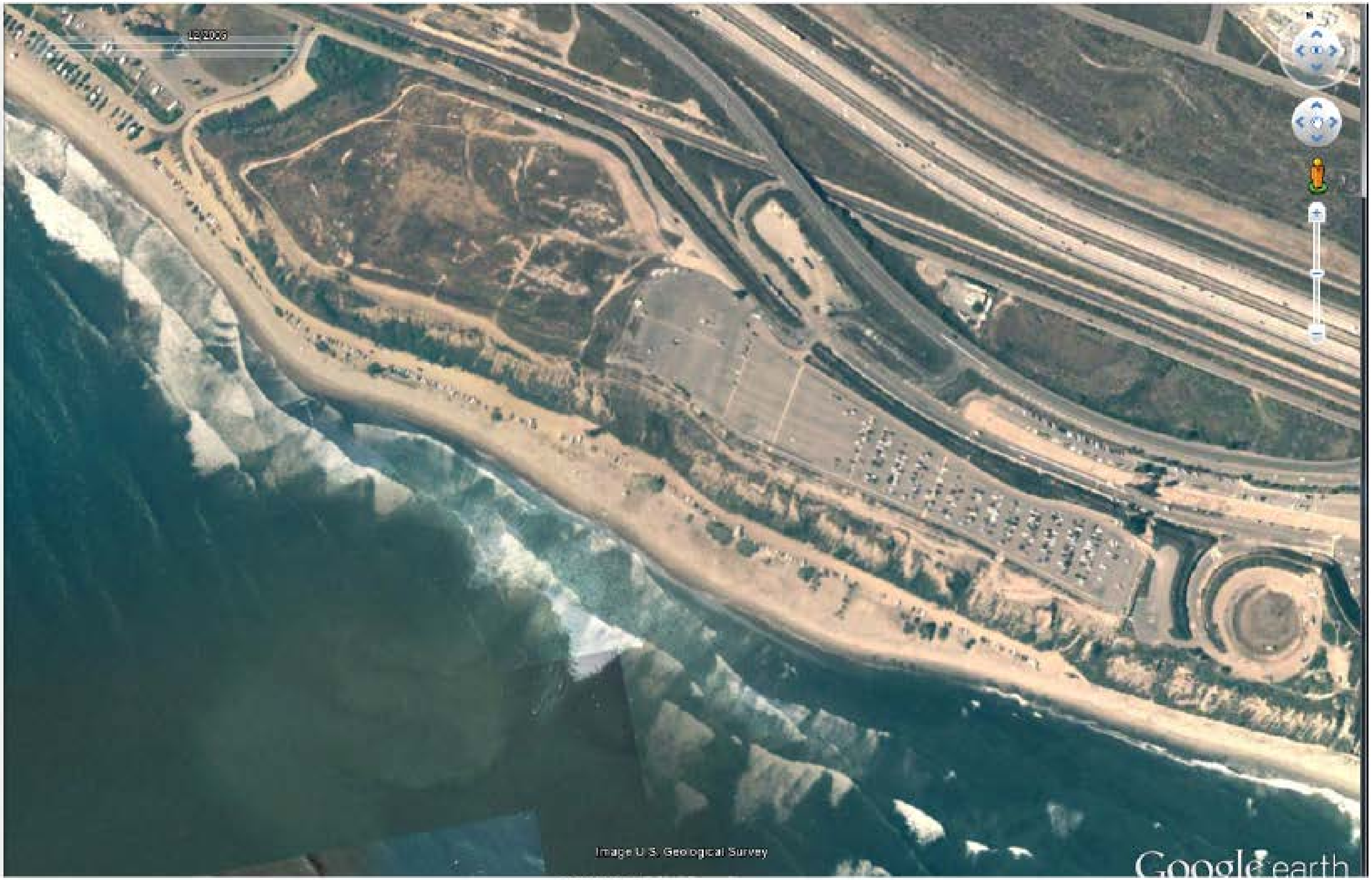
Nov. 2003

1994 2006 2018

Dec. 2003

1994 2006 2018

Dec. 2005



1994 2006 2018

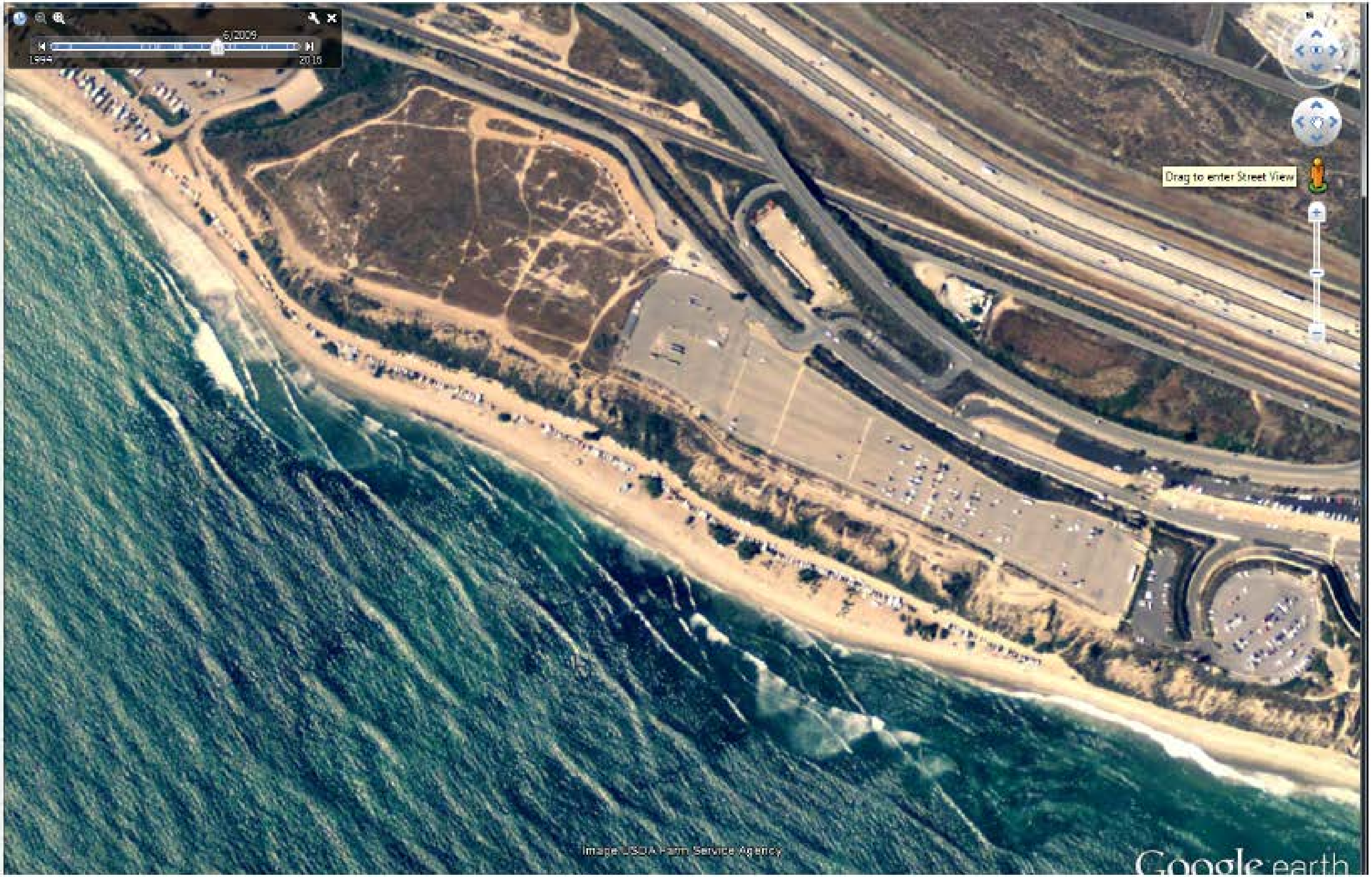
Feb. 2006

1994 2006 2018

Jan. 2008

1994 2006 2018

June 2009

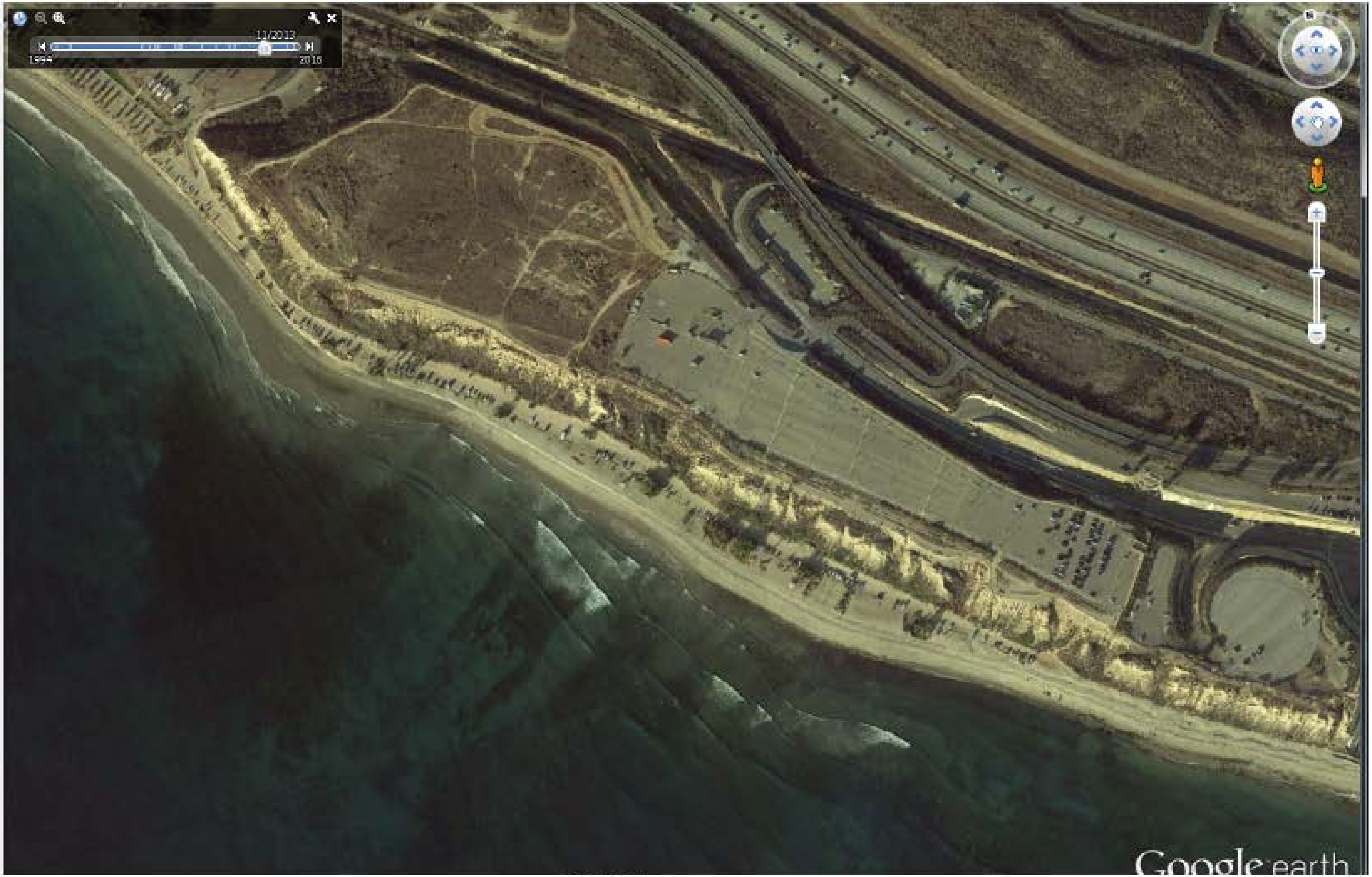


1994 2006 2018

Sept. 2010

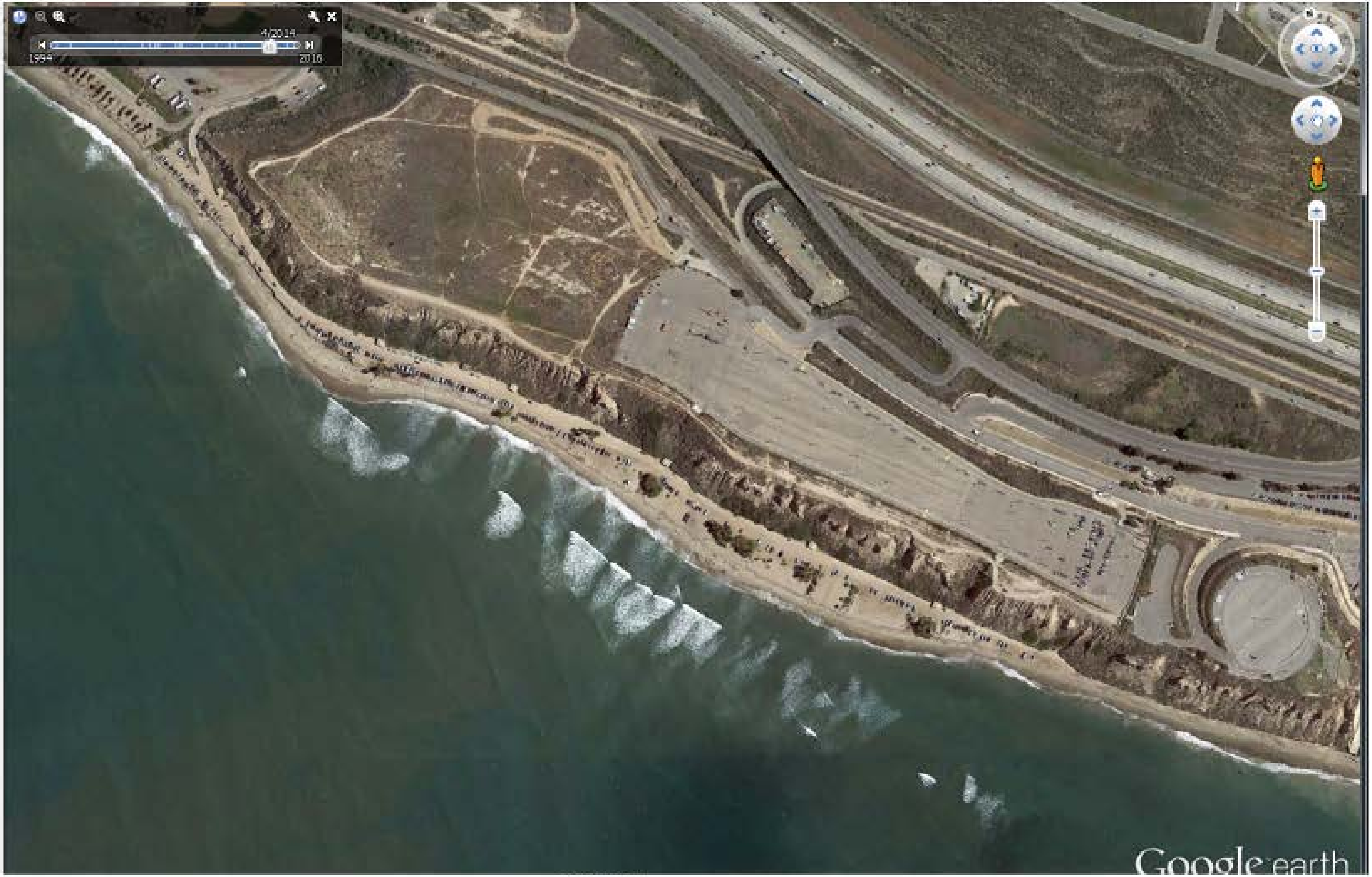
1994 2006 2018

Nov. 2013



1994 2006 2018

April 2014

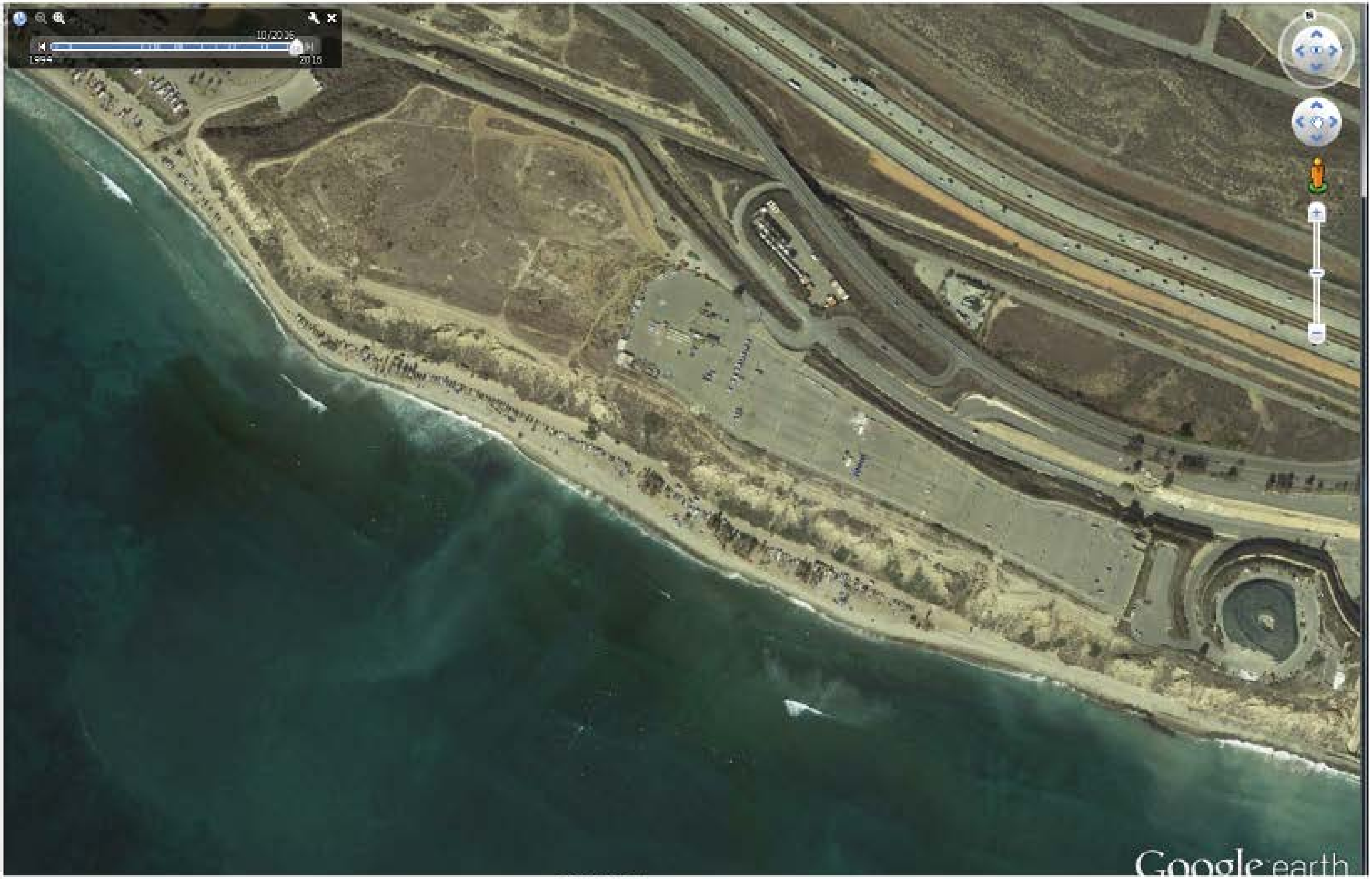


1994 2006 2018

Feb. 2016

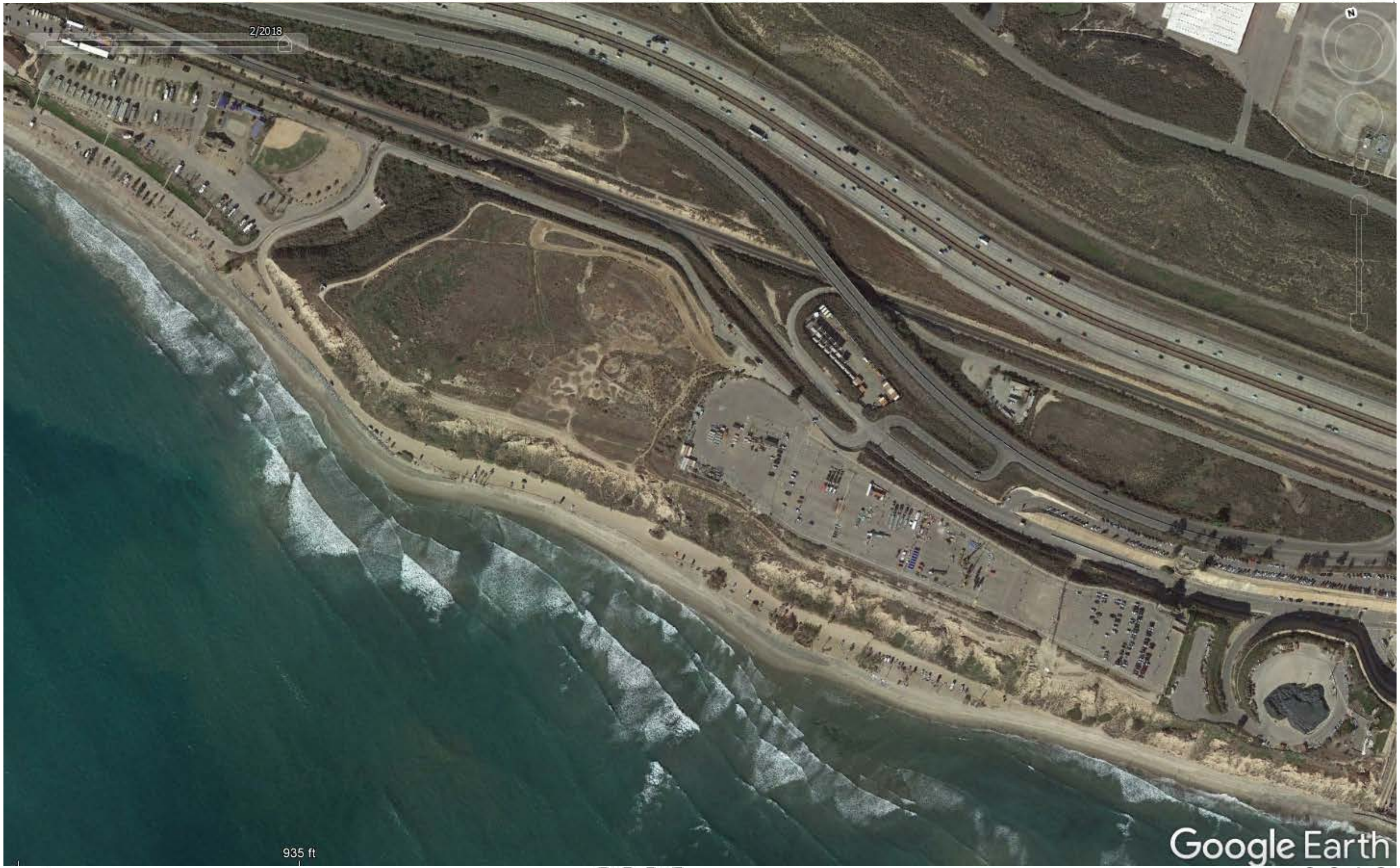
1994 2006 2018

Oct. 2016



1994 2006 2018

Oct. 2016



1994 2006 2018

APPENDIX E: WAVE RUNUP AND OVERTOPPING CALCULATIONS

INTRODUCTION TO EUROTOP MANUAL

The overtopping rate for the proposed revetment was estimated according to the methodology outlined in *EurOtop Wave Overtopping of Sea Defences and Related Structures: Assessment Manual* by Pullen, et al. (2007). Commonly referred to as the EurOtop manual, this document represents the most recent and comprehensive manual for calculating run-up and overtopping rates.

For these calculations, the existing beach fronting the parking lot, proposed coastal structures, and dunes were assumed to behave as a coastal dike. Chapter 5 of the EuroOtop manual outlines a methodology for calculating the overtopping rate over coastal dikes and embankment seawalls. This appendix describes this methodology, the input data, and the results. The MATLAB script used to implement the formulae presented herein is available upon request.

OVERTOPPING FORMULA

The EurOtop manual presents two formulae for estimating the overtopping rate; determination of the applicable formula is based on the wave breaking conditions. If the breaker parameter ($\xi_{m-1,0}$) is less than 5, the overtopping rate is calculated according to Equation 5.9, below:

$$\frac{q}{\sqrt{g * H_{m0}^3}} = \frac{0.067}{\sqrt{tan\alpha}}\gamma_b * \xi_{m-1,0} * \exp(-4.3 * \frac{R_c}{\xi_{m-1,0} * H_{m0} * \gamma_b * \gamma_\beta * \gamma_f})$$

with a maximum of: $\frac{q}{\sqrt{g * H_{m0}^3}} = 0.2 * \exp(-2.3 * \frac{R_c}{H_{m0} * \gamma_\beta * \gamma_f})$

where: q is the overtopping rate ($m^3/s/m$)

g is the gravitational constant (9.81 m/s^2)

H_{m0} is the significant wave height at the dike toe (m)

α is the slope angle

γ_b is the influence factor for a berm

$\xi_{m-1,0}$ is the breaker parameter, equal to $\frac{tan\alpha}{\sqrt{s_0}}$

s_0 is the slope of the wave

R_c is the crest freeboard (equal to the crest height minus the still water level) (m)

γ_β is the influence factor for oblique wave attack (assumed to be 1)

γ_f is the influence factor for roughness elements on a slope (assumed to be 0.9)

For $\xi_{m-1,0} > 7$, overtopping is calculated from Equation 5.11:

$$\frac{q}{\sqrt{g * H_{m0}^3}} = 0.21 * \exp(-1 * \frac{R_c}{H_{m0} * \gamma_\beta * \gamma_f * (0.33 + 0.022 * \xi_{m-1,0}})$$

For $5 < \xi_{m-1,0} < 7$, the overtopping rate should be linearly interpolated between the values calculated from Equations 5.9 and 5.11.

AVERAGE BERM SLOPE AND BERM INFLUENCE FACTOR

Equations 5.9 and 5.11 assume a constant slope (α), which is not the case for the present analysis. The revetment and dune structure, as designed, has two distinct slopes, separated by a flat berm. Thus, it was necessary to calculate an equivalent slope angle and a berm influence factor per Section 5.3.4.

Calculating the equivalent slope angle and the berm influence factor is an iterative process, based upon the geometry of the dike (which in turn influences the wave breaking conditions). The process begins with an initial estimate of the slope angle, which is calculated according to Equation 5.25:

$$tan\alpha = \frac{3H_{m0}}{L_{slope} - B}$$

where the slope length (L_{slope}) and berm width (B) can be seen in Figure A-1; note that this figure references H_s instead of H_{m0}.

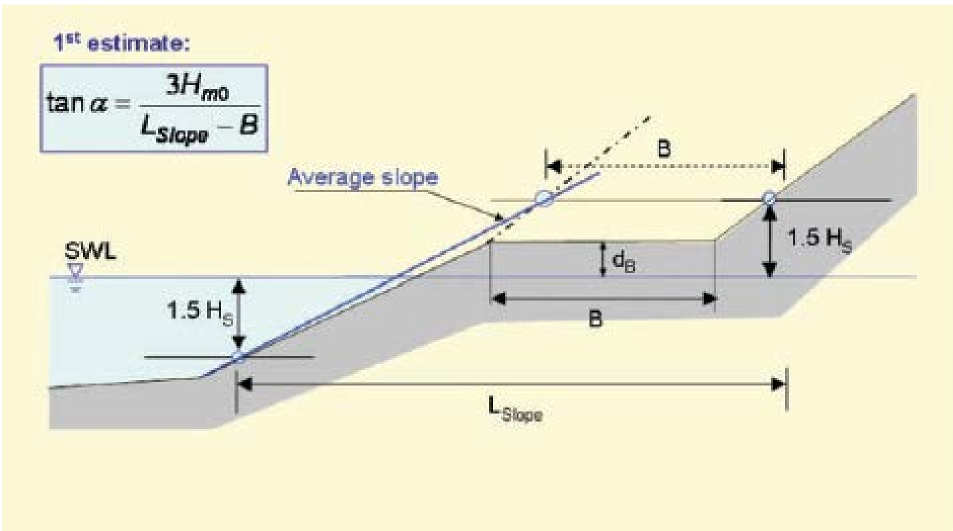


Figure A-1. Determination of the Average Slope (1st estimate)

Using this value for the slope angle, the 2 percent runup ($R_{u2\%}$) is calculated according to Equation 5.3:

$$\frac{R_{u2\%}}{H_{m0}} = 1.75 * \xi_{m-1,0} * \gamma_b * \gamma_\beta * \gamma_f$$

with a maximum of: $\frac{R_{u2\%}}{H_{m0}} = \gamma_b * \gamma_\beta * \gamma_f * (4.3 - \frac{1.6}{\sqrt{\xi_{m-1,0}}})$

Initially, γ_b was assumed equal to 0.8. In addition, the breaker parameter ($\xi_{m-1,0}$) was calculated based on the initial estimate of the slope angle. Using this value for $R_{u2\%}$, a new slope length and slope angle can be calculated according to Figure A-2 and a new slope angle can be calculated according to Equation 5.26:

$$tan\alpha = \frac{1.5 * H_{m0} + R_{u2\%}}{L_{slope} - B}$$

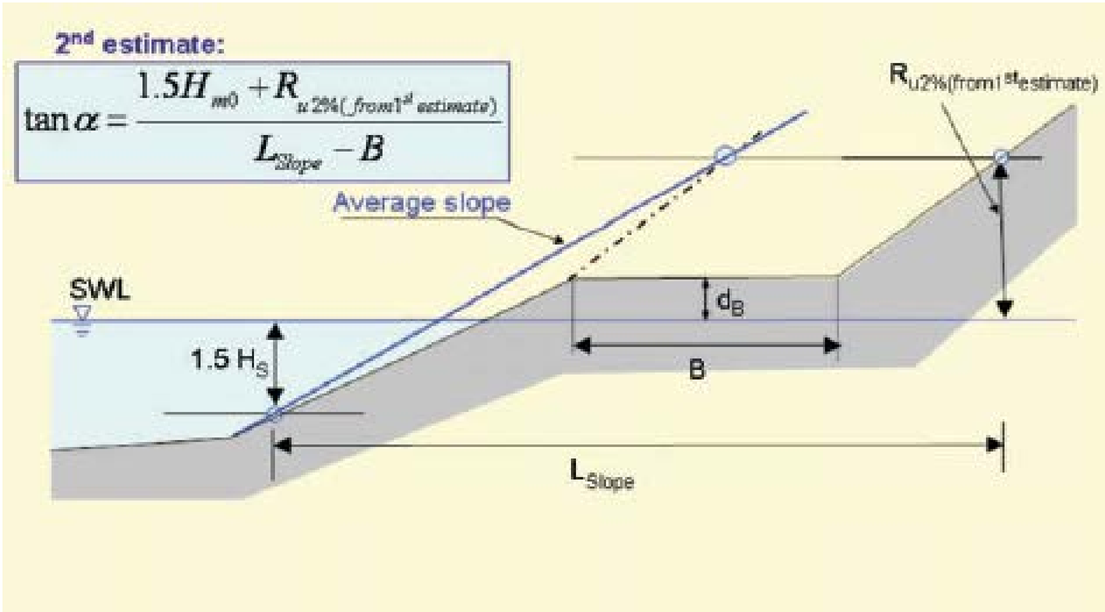


Figure A-2. Determination of the Average Slope (2nd estimate)

In addition to recalculating 2% run up, average slope angle, and slope length with each iteration, the breaker parameter ($\xi_{m-1,0}$) and berm influence factor (γ_b) are also recalculated. The new breaker parameter is based upon the new slope angle and the berm influence factor is calculated according to Equation 5.27:

$$\gamma_b = 1 - r_b * (1 - r_{db})$$

where: r_b is calculated as B/L_b

L_b is the berm length (see Figure A-3)

r_{db} is calculated as $0.5 - 0.5 * \cos(\pi \frac{d_b}{R_{u2\%}})$

d_b is the berm depth (see Figure A-3)

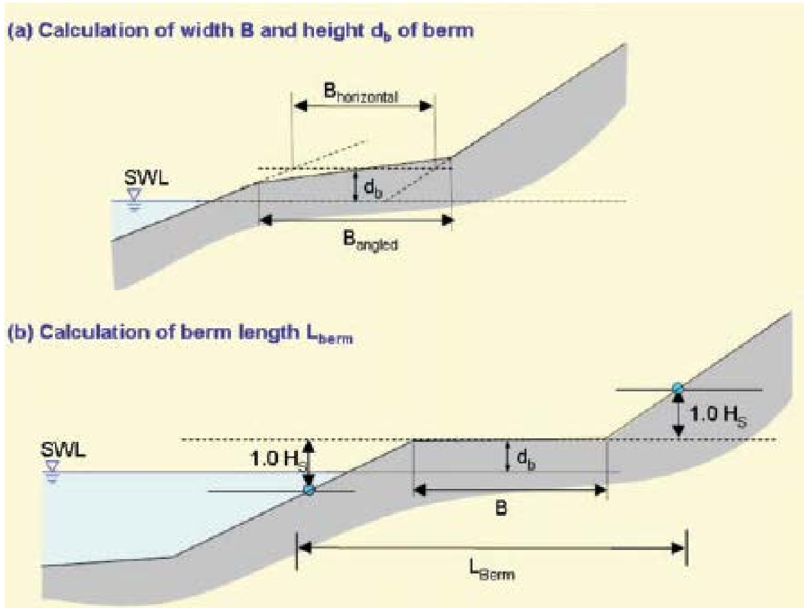


Figure A-3. Determination of Characteristic berm length L_b

This iterative process continued until the percent difference of the 2 percent run up from one iteration to the next was less than 1 percent. Once this process had completed, the average slope angle, breaker parameter and the berm influence factor was used in Equations 5.9 and 5.11 to calculate the overtopping rates.

ALT 1 - Revetment (crest +18 ft NAVD88)

		NO SLR		SLR +25cm		SLR +50cm
Parameter	**Units**	**Input**		**Input**		**Input**
Hs at Toe	m	2		2		2
Tp	s	16		16		16
Slope_upper	v:h	1:1.5		1:1.5		1:1.5
Slope_lower	v:h	1:8		1:8		1:8
SWL	m	0.77		1.02		1.27
Crest	m, NAVD88	5.49		5.49		5.49
Berm Elevation	m, NAVD88	2.44		2.44		2.44
Berm Width	m	0		0		0
Toe Elevation	m, NAVD88	0.61		0.61		0.61
Roughness Factor		0.60		0.60		0.60
		Output		**Output**		**Output**
q	l/s/m	0.21		0.34		0.54
ru2	m	3.85		3.88		3.91
Ru2 El	ft, NAVD88	15.2		16.1		17.0

ALT 2 - Seawall (crest +18 ft NAVD88)

		NO SLR		SLR +25cm		SLR +50cm
Parameter	**Units**	**Input**		**Input**		**Input**
Hs at Toe	m	2		2		2
Tp	s	16		16		16
Slope_upper	v:h	V		V		V
Slope_lower	v:h	1:8		1:8		1:8
SWL	m	0.77		1.02		1.27
Crest	m, NAVD88	5.49		5.49		5.49
Berm Elevation	m, NAVD88	2.44		2.44		2.44
Berm Width	m	0		0		0
Toe Elevation	m, NAVD88	0.61		0.61		0.61
Roughness Factor		1		1		1
		Output		**Output**		**Output**
q	l/s/m	7.78		10.37		13.83
ru2	m	6.37		6.42		6.46
Ru2 El	ft, NAVD88	23.4		24.4		25.4

ALT 3 -Beach Nourishment (crest +21 ft NAVD88)

		NO SLR		SLR +25cm		SLR +50cm
Parameter	**Units**	**Input**		**Input**		**Input**
Hs at Toe	m	2		2		2
Tp	s	16		16		16
Slope_upper	v:h	1:15		1:15		1:15
Slope_lower	v:h	1:8		1:8		1:8
SWL	m	0.77		1.02		1.27
Crest	m, NAVD88	6.40		6.40		6.40
Berm Elevation	m, NAVD88	2.44		2.44		2.44
Berm Width	m	15.24		15.24		15.24
Toe Elevation	m, NAVD88	0.61		0.61		0.61
Roughness Factor		1		1		1
		Output		**Output**		**Output**
q	l/s/m	0.03		0.03		0.03
ru2	m	3.78		3.62		3.48
Ru2 El	ft, NAVD88	14.9		15.2		15.6

ALT 4 - Cobble Berm (crest +8 ft NAVD88)

		NO SLR		SLR +25cm		SLR +50cm
Parameter	**Units**	**Input**		**Input**		**Input**
Hs at Toe	m	2		2		2
Tp	s	16		16		16
Slope_upper	v:h	1:10		1:10		1:10
Slope_lower	v:h	1:5		1:5		1:5
SWL	m	0.77		1.02		1.27
Crest	m, NAVD88	5.49		5.49		5.49
Berm Elevation	m, NAVD88	2.44		2.44		2.44
Berm Width	m	24.38		24.38		24.38
Toe Elevation	m, NAVD88	0.61		0.61		0.61
Roughness Factor		0.8		0.8		0.8
		Output		**Output**		**Output**
q	l/s/m	0.39		0.34		0.27
ru2	m	3.74		3.56		3.37
Ru2 El	ft, NAVD88	14.8		15.0		15.2

ALTS 5-7 - Existing Conditions

		NO SLR		SLR +25cm		SLR +50cm
Parameter	**Units**	**Input**		**Input**		**Input**
Hs at Toe	m	2		2		2
Tp	s	16		16		16
Slope_upper	v:h	1:8		1:8		1:8
Slope_lower	v:h	1:8		1:8		1:8
SWL	m	0.77		1.02		1.27
Crest	m, NAVD88	5.49		5.49		5.49
Berm Elevation	m, NAVD88	5.49		5.49		5.49
Berm Width	m	0		0		0
Toe Elevation	m, NAVD88	0.61		0.61		0.61
Roughness Factor		0.95		0.95		0.95
		Output		**Output**		**Output**
q	l/s/m	3.49		4.97		7.06
ru2	m	5.34		5.34		5.34
Ru2 El	ft, NAVD88	20.1		20.9		21.7

APPENDIX F: PRELIMINARY COST ESTIMATES

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 1 - Rock Revetment
Phase 2 - South End - 2,000 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$150,000**
	Mobilization	1	LS	$150,000.00	$150,000	
2	**Provide & Stockpile Material**					**$1,878,800**
	Underlayer Stone (1/4 ton)	11,000	TN	$44.00	$484,000	
	Armor Stone (3-5 ton)	25,000	TN	$54.00	$1,350,000	
	Geotextile Fabric	16,000	SY	$2.80	$44,800	
3	**Reinforced Concrete Roadway Edge**					**$64,000**
	Set PreCast Concrete Barrier	2,000	LF	$32.00	$64,000	
4	**Install Revetment**					**$431,000**
	Excavate and Backfill Site	2,000	LF	$50.00	$100,000	
	Place Geotextile Fabric	16,000	SY	$2.50	$40,000	
	Place Underlayer Stone	11,000	TN	$6.00	$66,000	
	Place Armor Stone (special placement)	25,000	TN	$9.00	$225,000	
5	**Miscellaneous**					**$40,000**
	Site Maintenance	2	MO	$5,000.00	$10,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$2,563,800**
6	**Construction Indirects**					**$809,135**
	Supervision	10%	%		$256,380	
	Bonds & insurance	4%	%		$112,807	
	Overhead & profit	15%	%		$439,948	
	Subtotal Construction Costs					**$3,372,935**
7	**Contingency**					**$337,294**
	Contingency	10%	%		$337,294	
	OPC GRAND TOTAL (ROUNDED)					**$3,700,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$1,110,000	**$4,800,000**
	Minus 20 Percent	-20%	%		$740,000	**$3,000,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 1 - Rock Revetment
Optional Stairway(s) Over Revetment

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$0**
	Mobilization	0	LS	$0.00	$0	
2	**Revetment Stairway**					**$40,000**
	Construct Stairway	1	LS	$40,000.00	$40,000	
	Subtotal Direct Costs					**$40,000**
6	**Construction Indirects**					**$12,624**
	Supervision	10%	%		$4,000	
	Bonds & insurance	4%	%		$1,760	
	Overhead & profit	15%	%		$6,864	
	Subtotal Construction Costs					**$52,624**
7	**Contingency**					**$7,894**
	Contingency	15%	%		$7,894	
	OPC GRAND TOTAL (ROUNDED)					**$60,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$30,000	**$90,000**
	Minus 30 Percent	-30%	%		$20,000	**$40,000**

Notes:
Price based on concept drawings
A suitable laydown area is provided at no cost to the contractor
Pricing is in US Dollars, 3rd quarter 2018
Price is based on unencumbered contractor access to the site
Contractor has access along beach for construction equipment
No weather risk included (force majeure)
Cost is based on locally available resources
Escalation expense is not included
Estimate class based on AACE No. 56R-08
Price does not include environmental restrictions
Price does not include any associated costs due to hazardous waste
Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 2 - Vertical Wall
Phase 1 - North End - 800 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$250,000**
	Mobilization	1	LS	$250,000.00	$250,000	
2	**Remove Emergency Revetment and Haul Offsite**					**$626,000**
	Underlayer Stone	4,400	TN	$40.00	$176,000	
	Armor Stone (3-6 ton)	8,900	TN	$50.00	$445,000	
	Geotextile Fabric	1	LS	$5,000.00	$5,000	
3	**Install Sheetpile Wall**					**$1,529,900**
	Purchase and install steel sheetpile	800	LF	$1,000.00	$800,000	
	Purchase and install tie-backs / soil anchors	80	EA	$8,000.00	$640,000	
	Excavate to place toe stone and backfill	800	LF	$100.00	$80,000	
	Place 6-8 ton toe stone (salvaged from emergency revetment)	1,100	TN	$9.00	$9,900	
4	**Install Architectural Concrete Fascia**					**$1,305,000**
	Purchase and install concrete cap and facing	700	CY	$1,500.00	$1,050,000	
	Purchase, place and sculpt shotcrete fascia	300	CY	$850.00	$255,000	
5	**Miscellaneous**					**$40,000**
	Site Maintenance	2	MO	$5,000.00	$10,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$3,750,900**
6	**Construction Indirects**					**$1,183,785**
	Supervision	10%	%		$375,090	
	Bonds & insurance	4%	%		$165,040	
	Overhead & profit	15%	%		$643,655	
	Subtotal Construction Costs					**$4,934,685**
7	**Contingency**					**$986,937**
	Contingency	20%	%		$986,937	
	OPC GRAND TOTAL (ROUNDED)					**$5,900,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$2,950,000	**$8,900,000**
	Minus 30 Percent	-30%	%		$1,770,000	**$4,100,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 2 - Vertical Wall
Phase 1 - North End - 800 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
	- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.					

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 2 - Vertical Wall
Phase 2 - South End - 2,000 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$250,000**
	Mobilization	1	LS	$250,000.00	$250,000	
2	**Install Sheetpile Wall**					**$3,869,300**
	Purchase and install steel sheetpile	2,000	LF	$1,000.00	$2,000,000	
	Purchase and install tie-backs / soil anchors	200	EA	$8,000.00	$1,600,000	
	Excavate to place toe stone and backfill	2,000	LF	$100.00	$200,000	
	Purchase and place 6-8 ton toe stone	1,100	TN	$63.00	$69,300	
3	**Install Architectural Concrete Fascia**					**$3,360,000**
	Purchase and install concrete cap and facing	1,900	CY	$1,500.00	$2,850,000	
	Purchase, place and sculpt shotcrete fascia	600	CY	$850.00	$510,000	
4	**Miscellaneous**					**$50,000**
	Site Maintenance	4	MO	$5,000.00	$20,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$7,529,300**
6	**Construction Indirects**					**$2,376,247**
	Supervision	10%	%		$752,930	
	Bonds & insurance	4%	%		$331,289	
	Overhead & profit	15%	%		$1,292,028	
	Subtotal Construction Costs					**$9,905,547**
7	**Contingency**					**$1,981,109**
	Contingency	20%	%		$1,981,109	
	OPC GRAND TOTAL (ROUNDED)					**$11,900,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$5,950,000	**$17,900,000**
	Minus 30 Percent	-30%	%		$3,570,000	**$8,300,000**

Notes:
Price based on concept drawings
A suitable laydown area is provided at no cost to the contractor
Pricing is in US Dollars, 3rd quarter 2018
Price is based on unencumbered contractor access to the site
Contractor has access along beach for construction equipment
No weather risk included (force majeure)
Cost is based on locally available resources
Escalation expense is not included
Estimate class based on AACE No. 56R-08
Price does not include environmental restrictions
Price does not include any associated costs due to hazardous waste
Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

Alternative 3 - Beach Nourishment - Import Sand from Offshore Borrow Site or Harbor
Phase 1 - North End - 800 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$2,000,000**
	Mobilization	1	LS	$2,000,000.00	$2,000,000	
2	**Provide and Place Sand**					**$480,000**
	Dredge sand from offshore borrow site, xport and pipe onto beach	60,000	CY	$8.00	$480,000	
	Spread sand and grade beach	40,000	SF	$2.40	$96,000	
3	**Miscellaneous**					**$45,000**
	Site Maintenance	2	MO	$5,000.00	$10,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$10,000.00	$10,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$2,525,000**
6	**Construction Indirects**					**$796,890**
	Supervision	10%	%		$252,500	
	Bonds & insurance	4%	%		$111,100	
	Overhead & profit	15%	%		$433,290	
	Subtotal Construction Costs					**$3,321,890**
7	**Contingency**					**$332,189**
	Contingency	10%	%		$332,189	
	OPC GRAND TOTAL (ROUNDED)					**$3,700,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$1,850,000	**$5,600,000**
	Minus 30 Percent	-30%	%		$1,110,000	**$2,600,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 3 - Beach Nourishment - Import Sand from Upland Source
Phase 1 - North End - 800 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$100,000**
	Mobilization	1	LS	$100,000.00	$100,000	
2	**Provide and Place Sand**					**$1,116,000**
	Excavate sand from source site (assume opportunistic source so no excavation cost)	60,000	CY	$0.00	$0	
	Load and transport sand to Surf Beach via truck and dump on beach	60,000	CY	$17.00	$1,020,000	
	Spread sand and grade beach	40,000	SF	$2.40	$96,000	
3	**Miscellaneous**					**$85,000**
	Site Maintenance	3	MO	$5,000.00	$15,000	
	Construction Barricades	1	LS	$10,000.00	$10,000	
	Erosion Control Management	1	LS	$20,000.00	$20,000	
	Site Restoration	1	LS	$40,000.00	$40,000	
	Subtotal Direct Costs					**$1,301,000**
6	**Construction Indirects**					**$410,596**
	Supervision	10%	%		$130,100	
	Bonds & insurance	4%	%		$57,244	
	Overhead & profit	15%	%		$223,252	
	Subtotal Construction Costs					**$1,711,596**
7	**Contingency**					**$171,160**
	Contingency	10%	%		$171,160	
	OPC GRAND TOTAL (ROUNDED)					**$1,900,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$950,000	**$2,900,000**
	Minus 30 Percent	-30%	%		$570,000	**$1,300,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 3 - Beach Nourishment - Import Sand from Offshore Borrow Site or Harbor
Phase 2 - South End - 2,000 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$2,000,000**
	Mobilization	1	LS	$2,000,000.00	$2,000,000	
2	**Provide and Place Sand**					**$1,200,000**
	Dredge sand from offshore borrow site, xport and pipe onto beach	150,000	CY	$8.00	$1,200,000	
	Spread sand and grade beach	100,000	SF	$2.40	$240,000	
3	**Miscellaneous**					**$55,000**
	Site Maintenance	4	MO	$5,000.00	$20,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$10,000.00	$10,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$3,255,000**
6	**Construction Indirects**					**$1,027,278**
	Supervision	10%	%		$325,500	
	Bonds & insurance	4%	%		$143,220	
	Overhead & profit	15%	%		$558,558	
	Subtotal Construction Costs					**$4,282,278**
7	**Contingency**					**$428,228**
	Contingency	10%	%		$428,228	
	OPC GRAND TOTAL (ROUNDED)					**$4,700,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$2,350,000	**$7,100,000**
	Minus 30 Percent	-30%	%		$1,410,000	**$3,300,000**

Notes:
Price based on concept drawings
A suitable laydown area is provided at no cost to the contractor
Pricing is in US Dollars, 3rd quarter 2018
Price is based on unencumbered contractor access to the site
Contractor has access along beach for construction equipment
No weather risk included (force majeure)
Cost is based on locally available resources
Escalation expense is not included
Estimate class based on AACE No. 56R-08
Price does not include environmental restrictions
Price does not include any associated costs due to hazardous waste
Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

Alternative 3 - Beach Nourishment - Import Sand from Upland Source
Phase 2 - South End - 2,000 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$100,000**
	Mobilization	1	LS	$100,000.00	$100,000	
2	**Provide and Place Sand**					**$2,790,000**
	Excavate sand from source site (assume opportunistic source so no excavation cost)	150,000	CY	$0.00	$0	
	Load and transport sand to Surf Beach via truck and dump on beach	150,000	CY	$17.00	$2,550,000	
	Spread sand and grade beach	100,000	SF	$2.40	$240,000	
3	**Miscellaneous**					**$100,000**
	Site Maintenance	6	MO	$5,000.00	$30,000	
	Construction Barricades	1	LS	$10,000.00	$10,000	
	Erosion Control Management	1	LS	$20,000.00	$20,000	
	Site Restoration	1	LS	$40,000.00	$40,000	
	Subtotal Direct Costs					**$2,990,000**
6	**Construction Indirects**					**$943,644**
	Supervision	10%	%		$299,000	
	Bonds & insurance	4%	%		$131,560	
	Overhead & profit	15%	%		$513,084	
	Subtotal Construction Costs					**$3,933,644**
7	**Contingency**					**$393,364**
	Contingency	10%	%		$393,364	
	OPC GRAND TOTAL (ROUNDED)					**$4,300,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$2,150,000	**$6,500,000**
	Minus 30 Percent	-30%	%		$1,290,000	**$3,000,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 4 - Cobble Berm
Phase 1 - North End - 800 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$150,000**
	Mobilization	1	LS	$150,000.00	$150,000	
2	**Remove Emergency Revetment and Haul Offsite**					**$681,000**
	Underlayer Stone	4,400	TN	$40.00	$176,000	
	Armor Stone (3-6 ton)	10,000	TN	$50.00	$500,000	
	Geotextile Fabric	1	LS	$5,000.00	$5,000	
3	**Provide & Stockpile Material**					**$1,127,000**
	Cobble	23,000	TN	$49.00	$1,127,000	
4	**Install Cobble Berm**					**$264,000**
	Excavate and Backfill Site	800	LF	$100.00	$80,000	
	Place Cobble	23,000	TN	$8.00	$184,000	
5	**Miscellaneous**					**$40,000**
	Site Maintenance	2	MO	$5,000.00	$10,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$2,262,000**
6	**Construction Indirects**					**$713,887**
	Supervision	10%	%		$226,200	
	Bonds & insurance	4%	%		$99,528	
	Overhead & profit	15%	%		$388,159	
	Subtotal Construction Costs					**$2,975,887**
7	**Contingency**					**$446,383**
	Contingency	15%	%		$446,383	
	OPC GRAND TOTAL (ROUNDED)					**$3,400,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$1,700,000	**$5,100,000**
	Minus 30 Percent	-30%	%		$1,020,000	**$2,400,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 4 - Cobble Berm
Phase 2 - South End - 2,000 LF

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$150,000**
	Mobilization	1	LS	$150,000.00	$150,000	
2	**Provide & Stockpile Material**					**$2,744,000**
	Cobble	56,000	TN	$49.00	$2,744,000	
3	**Install Cobble Berm**					**$648,000**
	Excavate and Backfill Site	2,000	LF	$100.00	$200,000	
	Place Cobble	56,000	TN	$8.00	$448,000	
4	**Miscellaneous**					**$50,000**
	Site Maintenance	4	MO	$5,000.00	$20,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Site Restoration	1	LS	$20,000.00	$20,000	
	Subtotal Direct Costs					**$3,592,000**
6	**Construction Indirects**					**$1,133,635**
	Supervision	10%	%		$359,200	
	Bonds & insurance	4%	%		$158,048	
	Overhead & profit	15%	%		$616,387	
	Subtotal Construction Costs					**$4,725,635**
7	**Contingency**					**$708,845**
	Contingency	15%	%		$708,845	
	OPC GRAND TOTAL (ROUNDED)					**$5,400,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$2,700,000	**$8,100,000**
	Minus 30 Percent	-30%	%		$1,620,000	**$3,800,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 5 - Active Road Maintenance
Phase 1A - Remove Emergency Revetment

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$50,000**
	Mobilization	1	LS	$50,000.00	$50,000	
2	**Remove Emergency Revetment and Haul Offsite**					**$681,000**
	Underlayer Stone	4,400	TN	$40.00	$176,000	
	Armor Stone (3-6 ton)	10,000	TN	$50.00	$500,000	
	Geotextile Fabric	1	LS	$5,000.00	$5,000	
3	**Miscellaneous**					**$15,000**
	Site Maintenance	1	MO	$5,000.00	$5,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Subtotal Direct Costs					**$746,000**
6	**Construction Indirects**					**$235,438**
	Supervision	10%	%		$74,600	
	Bonds & insurance	4%	%		$32,824	
	Overhead & profit	15%	%		$128,014	
	Subtotal Construction Costs					**$981,438**
7	**Contingency**					**$98,144**
	Contingency	10%	%		$98,144	
	OPC GRAND TOTAL (ROUNDED)					**$1,100,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$330,000	**$1,400,000**
	Minus 20 Percent	-20%	%		$220,000	**$900,000**

Notes: Price based on concept drawings
A suitable laydown area is provided at no cost to the contractor
Pricing is in US Dollars, 3rd quarter 2018
Price is based on unencumbered contractor access to the site
Contractor has access along beach for construction equipment
No weather risk included (force majeure)
Cost is based on locally available resources
Escalation expense is not included
Estimate class based on AACE No. 56R-08
Price does not include environmental restrictions
Price does not include any associated costs due to hazardous waste
Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 5 - Active Road Maintenance
Phase 1B - Maintain Road (Annual Cost) - Assume 5% of Road Needs to be Maintained per Year on Average

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$10,000**
	Mobilization	1	LS	$10,000.00	$10,000	
2	**Maintain Road**					**$29,500**
	Purchase and Import Native-Compatible Earthen Material (e.g. decomposed granite)	500	TN	$59.00	$29,500	
	Roadway compacting and grading	5,600	SF	$4.40	$24,640	
3	**Miscellaneous**					**$5,000**
	Remove Debris	1	LS	$3,000.00	$3,000	
	Construction Barricades	1	LS	$1,000.00	$1,000	
	Erosion Control Management	1	LS	$1,000.00	$1,000	
	Subtotal Direct Costs					**$44,500**
6	**Construction Indirects**					**$14,044**
	Supervision	10%	%		$4,450	
	Bonds & insurance	4%	%		$1,958	
	Overhead & profit	15%	%		$7,636	
	Subtotal Construction Costs					**$58,544**
7	**Contingency**					**$11,709**
	Contingency	20%	%		$11,709	
	OPC GRAND TOTAL (ROUNDED)					**$70,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$21,000	**$90,000**
	Minus 20 Percent	-20%	%		$14,000	**$60,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 5 - Active Road Maintenance

Phase 2A - Maintain Road - Assume 50% of Road Needs to be Maintained and Two Restrooms Need to be Removed Over this Time Period

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$20,000**
	Mobilization	1	LS	$20,000.00	$20,000	
2	**Maintain Road**					**$277,300**
	Purchase and import native-compatible earthen material (e.g. decomposed granite)	4,700	TN	$59.00	$277,300	
	Roadway compacting and grading	56,000	SF	$4.40	$246,400	
3	**Remove Chemical Toilet Restrooms**					**$10,000**
	Demolish and Dispose Buildings	2	EA	$5,000.00	$10,000	
4	**Miscellaneous**					**$7,000**
	Remove Debris	1	LS	$5,000.00	$5,000	
	Construction Barricades	1	LS	$1,000.00	$1,000	
	Erosion Control Management	1	LS	$1,000.00	$1,000	
	Subtotal Direct Costs					**$314,300**
6	**Construction Indirects**					**$99,193**
	Supervision	10%	%		$31,430	
	Bonds & insurance	4%	%		$13,829	
	Overhead & profit	15%	%		$53,934	
	Subtotal Construction Costs					**$413,493**
7	**Contingency**					**$82,699**
	Contingency	20%	%		$82,699	
	OPC GRAND TOTAL (ROUNDED)					**$500,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$150,000	**$650,000**
	Minus 20 Percent	-20%	%		$100,000	**$400,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

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San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 5 - Active Road Maintenance
Phase 2B- Assume Five (Remaining) Restrooms Need to be Removed

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$20,000**
	Mobilization	1	LS	$20,000.00	$20,000	
2	**Remove Chemical Toilet Restrooms**					**$25,000**
	Demolish and Dispose Buildings	5	EA	$5,000.00	$25,000	
3	**Miscellaneous**					**$7,000**
	Remove Debris	1	LS	$5,000.00	$5,000	
	Construction Barricades	1	LS	$1,000.00	$1,000	
	Erosion Control Management	1	LS	$1,000.00	$1,000	
	Subtotal Direct Costs					**$52,000**
6	**Construction Indirects**					**$16,411**
	Supervision	10%	%		$5,200	
	Bonds & insurance	4%	%		$2,288	
	Overhead & profit	15%	%		$8,923	
	Subtotal Construction Costs					**$68,411**
7	**Contingency**					**$6,841**
	Contingency	10%	%		$6,841	
	OPC GRAND TOTAL (ROUNDED)					**$80,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$24,000	**$100,000**
	Minus 20 Percent	-20%	%		$16,000	**$60,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

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San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 6 - Phased Retreat
Phase 1 - Remove Emergency Revetment

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$50,000**
	Mobilization	1	LS	$50,000.00	$50,000	
2	**Remove Emergency Revetment and Haul Offsite**					**$681,000**
	Underlayer Stone	4,400	TN	$40.00	$176,000	
	Armor Stone (3-6 ton)	10,000	TN	$50.00	$500,000	
	Geotextile Fabric	1	LS	$5,000.00	$5,000	
3	**Miscellaneous**					**$15,000**
	Site Maintenance	1	MO	$5,000.00	$5,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Subtotal Direct Costs					**$746,000**
6	**Construction Indirects**					**$235,438**
	Supervision	10%	%		$74,600	
	Bonds & insurance	4%	%		$32,824	
	Overhead & profit	15%	%		$128,014	
	Subtotal Construction Costs					**$981,438**
7	**Contingency**					**$98,144**
	Contingency	10%	%		$98,144	
	OPC GRAND TOTAL (ROUNDED)					**$1,100,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$330,000	**$1,400,000**
	Minus 20 Percent	-20%	%		$220,000	**$900,000**

Notes: Price based on concept drawings
A suitable laydown area is provided at no cost to the contractor
Pricing is in US Dollars, 3rd quarter 2018
Price is based on unencumbered contractor access to the site
Contractor has access along beach for construction equipment
No weather risk included (force majeure)
Cost is based on locally available resources
Escalation expense is not included
Estimate class based on AACE No. 56R-08
Price does not include environmental restrictions
Price does not include any associated costs due to hazardous waste
Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 6 - Phased Retreat
Phase 2 - Construct Bluff Retaining Wall and Remove Two Restrooms

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$250,000**
	Mobilization	1	LS	$250,000.00	$250,000	
2	**Construct Bluff Retaining Wall**					**$2,939,640**
	Install sheetpile wall	600	LF	$1,500.00	$900,000	
	Install wall tie-back anchors	60	EA	$8,000.00	$480,000	
	Purchase and install concrete cap and facing	500	CY	$1,500.00	$750,000	
	Purchase, place and sculpt shotcrete	230	CY	$850.00	$195,500	
	Clear and grub vegetation	40,000	SF	$2.00	$80,000	
	Excavate for new road location	12,000	CY	$5.00	$60,000	
	Haul off excavated material	12,000	CY	$35.00	$420,000	
	Purchase and import native-compatible earthen material (e.g. decomposed granite)	500	TN	$59.00	$29,500	
	Roadway compacting and grading	5,600	SF	$4.40	$24,640	
3	**Remove Chemical Toilet Restrooms on Beachfront**					**$10,000**
	Demolish and Dispose Buildings	2	EA	$5,000.00	$10,000	
4	**Miscellaneous**					**$15,000**
	Site Maintenance	1	MO	$5,000.00	$5,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Subtotal Direct Costs					**$3,214,640**
6	**Construction Indirects**					**$1,014,540**
	Supervision	10%	%		$321,464	
	Bonds & insurance	4%	%		$141,444	
	Overhead & profit	15%	%		$551,632	
	Subtotal Construction Costs					**$4,229,180**
7	**Contingency**					**$1,057,295**
	Contingency	25%	%		$1,057,295	
	OPC GRAND TOTAL (ROUNDED)					**$5,300,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$2,650,000	**$8,000,000**
	Minus 30 Percent	-30%	%		$1,590,000	**$3,700,000**

Notes:
Price based on concept drawings
A suitable laydown area is provided at no cost to the contractor
Pricing is in US Dollars, 3rd quarter 2018
Price is based on unencumbered contractor access to the site
Contractor has access along beach for construction equipment
No weather risk included (force majeure)
Cost is based on locally available resources
Escalation expense is not included
Estimate class based on AACE No. 56R-08
Price does not include environmental restrictions
Price does not include any associated costs due to hazardous waste
Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

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San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

Alternative 6 - Phased Retreat
Phase 3A - Construct Stairs from Bluff-top to Beach and Remove Two Restrooms

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$50,000**
	Mobilization	1	LS	$50,000.00	$50,000	
2	**Construct Timber-Tie Stairway**					**$263,000**
	Clear vegetation (heavy)	6,000	SF	$5.00	$30,000	
	Minor trenching for ties	1,500	SF	$10.00	$15,000	
	Grading allowance	1	LS	$150,000.00	$150,000	
	Purchase and install heavy-duty timber ties	200	EA	$120.00	$24,000	
	Purchase and install steel stakes	400	EA	$20.00	$8,000	
	Install stone sill	2,400	SF	$5.00	$12,000	
	Install wattles along sides of trail	600	LF	$40.00	$24,000	
3	**Remove Chemical Toilet Restrooms on Beachfront**					**$10,000**
	Demolish and Dispose Buildings	2	EA	$5,000.00	$10,000	
4	**Install Chemical Toilet Restroom on Bluff-top**					**$250,000**
	Construct restroom on septic tank	1	EA	$250,000.00	$250,000	
5	**Miscellaneous**					**$15,000**
	Site Maintenance	1	MO	$5,000.00	$5,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Subtotal Direct Costs					**$588,000**
6	**Construction Indirects**					**$185,573**
	Supervision	10%	%		$58,800	
	Bonds & insurance	4%	%		$25,872	
	Overhead & profit	15%	%		$100,901	
	Subtotal Construction Costs					**$773,573**
7	**Contingency**					**$154,715**
	Contingency	20%	%		$154,715	
	OPC GRAND TOTAL (ROUNDED)					**$900,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$450,000	**$1,400,000**
	Minus 30 Percent	-30%	%		$270,000	**$600,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

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Alternative 6 - Phased Retreat
Phase 3B - Construct Road from Bluff-top to Beach and Remove Three (Remaining) Restrooms

Opinion of Probable Cost

Date prepared: September 25, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$250,000**
	Mobilization	1	LS	$250,000.00	$250,000	
2	**Construct Earthen Road**					**$3,162,300**
	Clear vegetation (heavy)	15,000	SF	$2.00	$30,000	
	Import and place fill material	50,000	CY	$40.00	$2,000,000	
	Purchase and install road base	900	TN	$59.00	$53,100	
	Purchase and install AC pavement	700	TN	$40.00	$28,000	
	Purchase and install reinforced soil stabilization along sides of road	12,200	SF	$70.00	$854,000	
	Purchase and install barrier/guard rails	900	LF	$150.00	$135,000	
	Construct drainage ditch on each side of road	100	CY	$175.00	$17,500	
	Install chain barrier gate at top of road	1	LS	$2,000.00	$2,000	
	Road landing pad (earthen material) on beach	300	TN	$59.00	$17,700	
	Road approach concrete slab on top of bluff	1	LS	$25,000.00	$25,000	
3	**Remove Chemical Toilet Restrooms on Beachfront**					**$15,000**
	Demolish and Dispose Buildings	3	EA	$5,000.00	$15,000	
4	**Install Chemical Toilet Restroom on Bluff-top**					**$250,000**
	Construct restroom on septic tank	1	EA	$250,000.00	$250,000	
5	**Miscellaneous**					**$85,000**
	Site Maintenance	6	MO	$5,000.00	$30,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$50,000.00	$50,000	
	Subtotal Direct Costs					**$3,762,300**
6	**Construction Indirects**					**$1,187,382**
	Supervision	10%	%		$376,230	
	Bonds & insurance	4%	%		$165,541	
	Overhead & profit	15%	%		$645,611	
	Subtotal Construction Costs					**$4,949,682**
7	**Contingency**					**$1,484,905**
	Contingency	30%	%		$1,484,905	
	OPC GRAND TOTAL (ROUNDED)					**$6,400,000**
	Class 5 Estimate					
	Plus 50 Percent	50%	%		$3,200,000	**$9,600,000**
	Minus 30 Percent	-30%	%		$1,920,000	**$4,500,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 6 - Phased Retreat
Phase 3B - Construct Road from Bluff-top to Beach and Remove Three (Remaining) Restrooms

Opinion of Probable Cost

Date prepared: September 25, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

Alternative 7 - Limited Action
Phase 1 - Remove Emergency Revetment

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$50,000**
	Mobilization	1	LS	$50,000.00	$50,000	
2	**Remove Emergency Revetment and Haul Offsite**					**$681,000**
	Underlayer Stone	4,400	TN	$40.00	$176,000	
	Armor Stone (3-6 ton)	10,000	TN	$50.00	$500,000	
	Geotextile Fabric	1	LS	$5,000.00	$5,000	
5	**Miscellaneous**					**$15,000**
	Site Maintenance	1	MO	$5,000.00	$5,000	
	Construction Barricades	1	LS	$5,000.00	$5,000	
	Erosion Control Management	1	LS	$5,000.00	$5,000	
	Subtotal Direct Costs					**$746,000**
6	**Construction Indirects**					**$235,438**
	Supervision	10%	%		$74,600	
	Bonds & insurance	4%	%		$32,824	
	Overhead & profit	15%	%		$128,014	
	Subtotal Construction Costs					**$981,438**
7	**Contingency**					**$98,144**
	Contingency	10%	%		$98,144	
	OPC GRAND TOTAL (ROUNDED)					**$1,100,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$330,000	**$1,400,000**
	Minus 20 Percent	-20%	%		$220,000	**$900,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

San Onofre State Beach - Surf Beach
California Department of Parks and Recreation

moffatt & nichol

Alternative 7 - Limited Action
Phase 2 - Remove all seven restrooms

Opinion of Probable Cost

Date prepared: June 20, 2018
M&N Job Number: 9280-S6

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$20,000**
	Mobilization	1	LS	$20,000.00	$20,000	
4	**Remove Chemical Toilet Restrooms**					**$35,000**
	Demolish and Dispose Buildings	7	EA	$5,000.00	$35,000	
5	**Miscellaneous**					**$7,000**
	Remove Debris	1	LS	$5,000.00	$5,000	
	Construction Barricades	1	LS	$1,000.00	$1,000	
	Erosion Control Management	1	LS	$1,000.00	$1,000	
	Subtotal Direct Costs					**$62,000**
6	**Construction Indirects**					**$19,567**
	Supervision	10%	%		$6,200	
	Bonds & insurance	4%	%		$2,728	
	Overhead & profit	15%	%		$10,639	
	Subtotal Construction Costs					**$81,567**
7	**Contingency**					**$8,157**
	Contingency	10%	%		$8,157	
	OPC GRAND TOTAL (ROUNDED)					**$90,000**
	Class 4 Estimate					
	Plus 30 Percent	30%	%		$27,000	**$120,000**
	Minus 20 Percent	-20%	%		$18,000	**$70,000**

Notes:
- Price based on concept drawings
- A suitable laydown area is provided at no cost to the contractor
- Pricing is in US Dollars, 3rd quarter 2018
- Price is based on unencumbered contractor access to the site
- Contractor has access along beach for construction equipment
- No weather risk included (force majeure)
- Cost is based on locally available resources
- Escalation expense is not included
- Estimate class based on AACE No. 56R-08
- Price does not include environmental restrictions
- Price does not include any associated costs due to hazardous waste
- Owner's costs (engineering, project management, owners overhead, third party QA/QC, etc.) are not included

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

APPENDIX G: DRAFT BEACH MONITORING PLAN

Preliminary Beach Profile & Surf Monitoring Plan for San Onofre State Beach, Surf Beach

1.1 Purpose & Objectives

Placement of shoreline protective structures has been previously documented to result in impacts to surrounding beaches, including reduction of beach access, loss of sand supply from bluffs, beach loss through passive erosion, and alteration of recreational surf conditions. Beach profile and surf monitoring will be conducted at Surf Beach to document any such effects that may result from the placement of the revetment structure. Monitoring will focus on the revetment as well as any additional, future shoreline management actions implemented along Surf Beach. Results of the beach profile and surf monitoring will be used to evaluate retention or removal of the revetment as well as need for further management actions along Surf Beach.

In addition to the methods described below, Orange Coast District is working with the University of California, Irvine's (UCI) Environmental Engineering program on a partnership to ensure that the latest and most effective methodologies and techniques are informing our coastal monitoring program decisions. Any proposed alternative method(s) for shoreline or surf monitoring would be provided to the Coastal Commission for review and approval.

Main goals of the monitoring program are:

1. To objectively quantify (and qualify) the amount of change observed in shoreline and surf conditions over time, both as a consequence of large-scale natural forces (e.g. storm events, extreme tides, and seal level rise) and local management actions to protect beach access (e.g. rock revetments, beach nourishment, etc.).
2. To provide the data necessary to identify when an established trigger (or threshold of impact) is met and new or alternative management actions are to be considered.

1.2 Beach Profile Monitoring Methods and Transect Locations

1.2.1 Overview

There are two types of beach profile monitoring which can be conducted to provide shoreline information: a) surveys along full-length profiles from the toe of the bluff out to the offshore "depth of closure" and b) surveys along shorter transect out to wading depth. Due to the significant cost involved with the former (full-length) profiles, State Parks will consider the full-length transects if additional funding becomes available. All transects will be perpendicular to the shoreline.

Six wading depth transects (W1 to W6) will be established along Surf Beach, which can be used to monitor the beach on a more frequent basis (Figure 1). These transects will be located along the length of Surf Beach in locations that will provide data to determine if trigger thresholds have been reached (see section 1.5 on Trigger Criteria below), including the beach widths fronting the revetment and restroom facilities. Included in the six wading depth transects are locations immediately up-coast and down-coast of the revetment to monitor for varying erosional patterns compared to the area fronting the revetment.

Figure 1: Beach Profile Monitoring Transect Locations along Surf Beach.

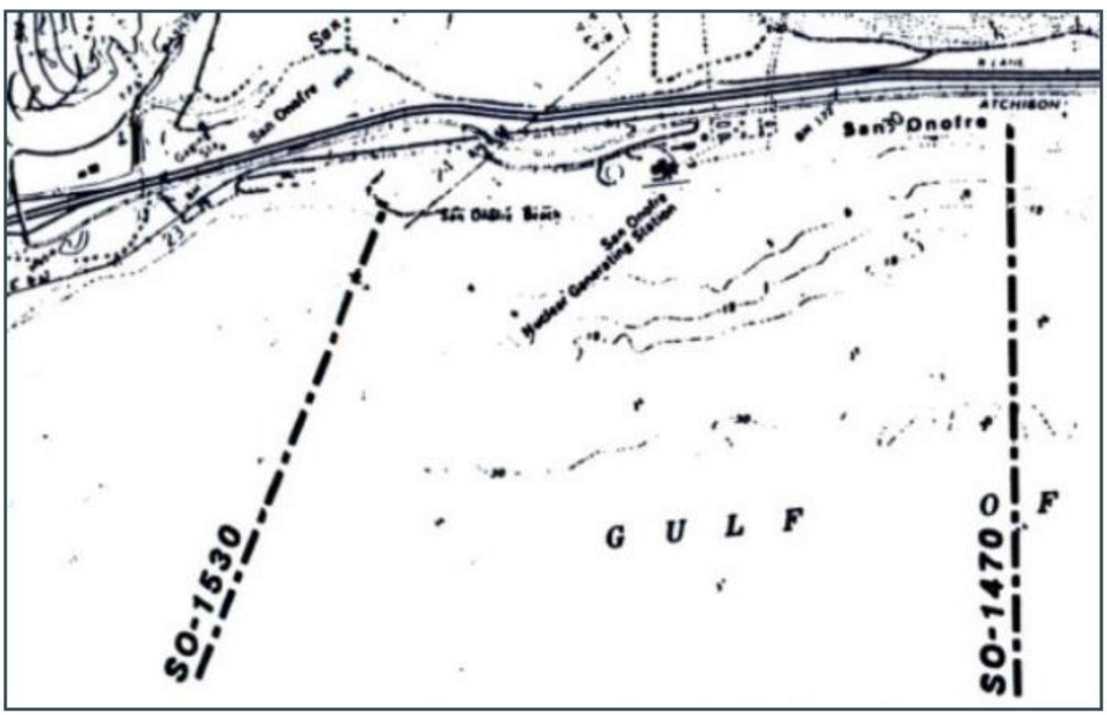

Figure 2: Historical USACE Transect Locations along San Onofre State Beach

As funding allows, six full-length transects will be monitored: four full-length transects along Surf Beach (including SB1 and SB2 transects immediately up-coast and down-coast of the existing emergency revetment, respectively) and two full-length control transects farther up-coast and down-coast of Surf Beach, as shown in Figure 1. The control transects will provide data to understand regional conditions. The SB1 and downcoast control transects correspond to historical USACE monitoring at transects SO-1530 and SO-1470, respectively (Figure 2). The depth of closure in the area is approximately -20 feet MLLW, based on USACE Wave Information Studies; surveying along transects out to the depth of closure provides information regarding cross-shore (shore-perpendicular) sand movement which typically occurs on a seasonal basis.

Additionally, State Parks will monitor and record the number of times per year road repairs are required and made along the entire stretch of road, including along the existing revetment section. This will allow us to document the number of wave events that overtop the revetment and cause substantial damage to the road.

1.2.2 Wading Depth Transects Profile Methods

We will record wading depth profiles by extending data collection along each transect from the toe of the bluff to wading depth. As part of the wading depth surveying, the width of different features of Surf Beach will be monitored, including the width of the road, dry beach berm, and cobble field.

The Emery beach profiling method will be used to collect data on beach width and elevation along the wading depth transects. The Emery beach profiling method is a simple, reliable technique to measure width and elevation change along the beach relative to a non-moving point, the horizon. The method uses two 1.5 m long measuring rods connected by a 2 m long rope. Rods are held vertical and extended in a line perpendicular to the shoreline (i.e. a transect). The horizon line is used to estimate the difference in elevation between the two positions (See Figure 3). The method is repeated along a transect line from a fixed reference mark on the upper part of the beach (e.g. base of the coastal bluff) towards the ocean. Measurements can be taken into the surf zone to generate profiles at wading depth. The method requires three people (staff and/or volunteers); two to hold and move each rod and one to record data on a field form.

In addition to documenting change in the beach profile over time, the resulting transect data will be used to locate the approximate mean high tide line (or mean high water level (MHW)) along the beach profile. Based on the nearest NOAA tide gage, the MHW for Surf Beach is approximately +4.6 feet relative to the mean lower-low water (MLLW) datum. The location of the MHW elevation intersection on the beach profile can be interpolated from the recorded transect information. The horizontal distances between the MHW location and: a) edge of parking lot, b) seaward edge of restroom and c) toe of the bluff will be calculated for each transect location during each monitoring event. In turn, these distances are used as triggers for potential management action (see table in Section 1.5).

1.2.3 Full- Length Transects Profile Methods

Bathymetric survey of the elevations along each profile out to the closure depth will likely be done by boat and typical side-scan sonar imaging. In addition to data on beach elevation and width, the full-length profile monitoring will also collect information on beach road width, road conditions, coastal infrastructure conditions, and the risk level of Surf Beach facilities where applicable.

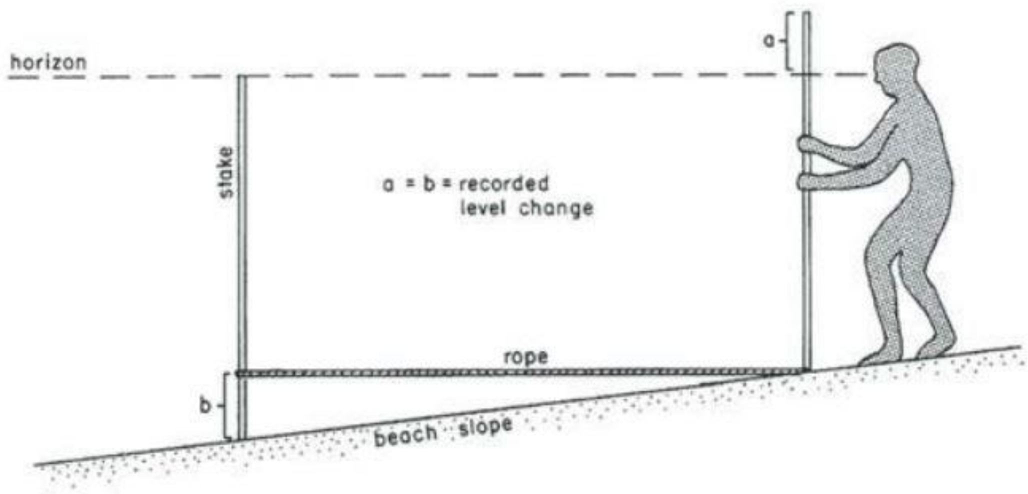

Figure 3. The Emery Method for beach profiling.

1.2.4 Photo Monitoring

During all surveys, Parks will take photographs from several fixed photo point locations to monitor change in the shoreline. Photos will capture shoreline profiles at the revetment as well as up- and down-coast. Notes and photographs will also be taken to document scour pockets, evidence of wave overtopping, the presence of rip currents, scarps present, and severe erosion.

1.2.5 Schedule

Survey along the full-length transects will be conducted twice annually during March and October, capturing end of winter and summer conditions respectively. This biannual sampling approach will account for seasonal fluctuations in beach widths and offshore sand deposition due to the presence of greater wave energy in winter months. If budgetary constraints are not a concern additional monitoring will be conducted in June and December to further capture seasonal fluctuations.

Wading depth surveys along the shorter transects will be conducted once per month during the late-fall and winter months and generally every other month during the other times of year, i.e. surveys to be November, December, January, February, April, June, and August (8 times per year).

1.3 Surf Monitoring

One concern with shoreline protection structures like rock revetments is their potential to negatively alter wave breaking characteristics at existing surf breaks. To monitor for impacts of the revetment on surf at Surf Beach, State Parks will collect a variety of data at least twice a month during mid-tide when wave heights are forecasted to be 3 feet or greater. This includes recording the following information on a standardized Surf Monitoring Form (see Figure 4 below):

a) **Wave height range** (compare with published online reports. Wave heights are reported twice daily for Surf Beach (The Point) at Surfline.com).
b) **Wave period** (obtain from daily Surfline.com report).
c) **Wind speed and direction** (obtain from daily Surfline.com report).

d) **Surfability / Wave condition**. Wave condition is a subjective measure of surf quality dependent on wave height, current winds, tide, and swell direction. See Form for categories of Surfability.

e) **Wave type** (several descriptors that help capture the nature of the waves at a particular moment in time. Can be determined in the field).

f) **% Unsurfable**, calculated by dividing the number of non-rideable waves by the total number of breaking waves observed in a 30 minute period (the inverse is the % surfable waves).

g) **% Backwash.** Because backwash is an anticipated, potential effect of a revetment, the frequency of backwash events will be estimated. % backwash is the number of surfable waves with backwash present on the wave face divided by the total number of surfable waves in the same 30 minute period.

h) **Three-minutes of video of the surf zone** to capture a complete range of wave break characteristics.

<table>
<tr><td colspan="2">OBSERVER</td><td>DATE</td></tr>
<tr><td>STATION ID</td><td>TIME (24Hr)</td><td>SURFER COUNT
SUP | LB | SB | BB | BS</td></tr>
<tr><td>WIND SPEED/SEASTATE (Beaufort Scale)
OFFSHORE 0 1 2 3 4 5 6 7 8 9 10
INSHORE 0 1 2 3 4 5 6 7 8 9 10</td><td colspan="2">BACKWASH yes / no
PEEL DIRECTION R L R/L
WIND DIRECTION IN SURF ZONE ONSHORE OFFSHORE CALM</td></tr>
<tr><td></td><td>LEFTS</td><td>RIGHTS</td></tr>
<tr><td>WAVE HEIGHT (FT)</td><td>LOW - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+
HIGH - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+</td><td>LOW - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+
HIGH - 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15+</td></tr>
<tr><td>SURFABILITY</td><td>Excellent | Good to Excellent | Good |Fair to Good
Fair | Poor to Fair | Poor | Ex Poor | Not Breaking</td><td>Excellent | Good to Excellent | Good |Fair to Good
Fair | Poor to Fair | Poor | Ex Poor | Not Breaking</td></tr>
<tr><td>WAVE TYPE</td><td>Short / Long / Mixed | Mushy / Steep / Hollow
Slow / Fast | Tight / Spread / Peaky / Shifty
NoSho/ SmlSho / P-ling / Sect / Walled / Closed
Weak / Punchy / Powerful
Con. / Incon. / Very Incon. / Flat</td><td>Short / Long / Mixed | Mushy / Steep / Hollow
Slow / Fast | Tight / Spread / Peaky / Shifty
NoSho/ SmlSho / P-ling / Sect / Walled / Closed
Weak / Punchy / Powerful
Con. / Incon. / Very Incon. / Flat</td></tr>
<tr><td>% Unsurfable</td><td>0 / 1-20 / 21-79 / 80-99 / 100</td><td>0 / 1-20 / 21-79 / 80-99 / 100</td></tr>
<tr><td colspan="3">COMMENTS:</td></tr>
</table>

Figure 4: Standardized Surf Monitoring Form for Surf Beach

1.4 Reporting

Results from all monitoring efforts (revetment, shoreline and surf monitoring) will be summarized and reported to the Coastal Commission on an annual basis. The annual report will also address the extent to which (based on monitoring data) the revetment is causing down-coast erosion, impacting surf conditions, or having other impacts at Surf Beach. Finally, the report will include recommendations for adapting monitoring plan methodology over time.

1.5 Trigger Criteria

Pre-determined "trigger criteria" can aid in deciding upon the retention or removal of the emergency revetment, as well as the need for further shoreline management actions along Surf Beach. The Surf Beach monitoring program would provide the data to determine if these pre-determined criteria (thresholds) have been reached and thus trigger the need for action. The table below summarizes the proposed trigger criteria for various actions over near-term to long-term time horizons.

Time Horizon	Action	Monitoring Parameter	Trigger Criteria/Threshold *
Current	Remove the rock revetment	Beach width	Dry beach berm width of 40 feet or more fronting (seaward of) the revetment sustained year-round for a five-year period.
		Surf	Surf monitoring indicates the revetment is causing substantial adverse effects on surf conditions, particularly frequent backwash on the face of rideable waves.
		Wave Overtopping and Repairs Frequency	Revetment no longer effective in preventing wave overtopping, i.e. waves frequently overtop revetment and damage occurs to the parking lot/road along the location of revetment more than twice per year.
		Beach width and Repairs Frequency	Beach erosion immediately downcoast of the revetment is following a multi-year demonstrably altered erosional pattern than elsewhere at Surf Beach (based on comparisons with control transect data and other shoreline data TBD) AND/OR the access road immediately downcoast of the emergency revetment (the first 100 feet) erodes to a width of less than 30 feet AND requires repairs more than once a year for three consecutive years to maintain a width of 30 feet.
Current to Medium Term	Retain the revetment	Beach width	Occurrence of dry beach berm width of less than 40 feet fronting (seaward of) the revetment during a five-year period.
		Surf	Surf monitoring indicates the revetment is not causing adverse effects on surfing or down-coast erosional patterns, i.e. particularly backwash not frequently occurring on the face of rideable waves.
Current to Medium Term	Implement alternative shoreline protection segments and/or phased retreat along unprotected segments of Surf Beach	Beach width	Beach erodes (mean high tide line) to within 50 feet of restroom
		Beach width	Beach erodes (mean high tide line) within 40 feet from landward edge of parking lot/road where restrooms not present
		Repairs Frequency	The parking lot and road have to be repaired/re-graded more than twice per year over a five-year period.
Long Term	Remove all facilities along the Surf Beach shoreline	Beach width	Mean high tide line within 20 feet of the toe of the bluff

** If any of these occur, the action will be triggered.*

June 6, 2019

To: Dayna Bochco, Chair, California Coastal Commission

CC: Jack Ainsworth, Executive Director, California Coastal Commission
Karl Schwing, Deputy Director California Coastal Commission
Alex Llerandi, Coastal Program Analyst

Re: Comments on Application 9-19-0194 San Onofre State Park Surf Beach Revetment (Th20b)

Dear Chair Bochco:

As an organization dedicated to beach access, shoreline preservation and protection of coastal resources, Surfrider Foundation (Surfrider) opposes coastal armoring at San Onofre State Beach (aka Surf Beach) as a long term erosion management strategy.

As a state agency committed to protection and preservation of coastal resources, **State Parks' response to an erosion event is disheartening and shamefully inconsistent with the state of California's recommended guidance on responding to coastal erosion and sea level rise hazards.** The California Ocean Protection Council's *Sea Level Rise Guidance* as well as the California Coastal Commission's *2015 Sea Level Rise Policy Guidance* and *2018 Science Update* all clearly call for avoidance of hard armoring and implementation of adaptation measures that maintain or restore natural coastal processes.

Timeline:

- February 2017: Winter storm swells cause wave overtopping, closing access road for several days;
- April 2017: State Parks receives emergency permit to install a 900-foot revetment despite the fact sand and cobble had accumulated at the beach and wave overtopping was no longer an issue; further, the park was closed for far more days (over 20) due to construction of the revetment than it was during the winter flooding; State Parks is to remove the revetment by November;
- November 2017: State Parks ignores the Coastal Commission's hard deadline for removal of the revetment;
- May 2018: Predictably and belatedly, State Parks asks for a permit extension;
- June 2019: State Parks applies for permit to retain the revetment indefinitely.

This reflects a major flaw in the Coastal Commission's emergency permitting practices for two reasons:

First, in this case and in countless others, the emergency development that was permitted was by no means a temporary structure. This is evident in the size, scale and nature of the seawall. It was certainly not the minimum development necessary to address the erosion situation.

P.O. Box 73550, San Clemente, CA 92673 | info@surfrider.org | 949.492.8170 | surfrider.org

EXHIBIT NO. 7
APPLICATION NO.
6-18-1089
Surfrider comment letter
California Coastal Commission

The 800-foot rock revetment and concrete retaining wall that State Parks installed is composed of 3 to 8-ton boulders placed directly on Surf Beach, measuring approximately 15 feet in width and 12 feet in height as well as an approximately 5-foot deep concrete wall dug into the existing roadway.

According to the Coastal Commission's own application for emergency permits, "an [emergency permit] is a temporary authorization designed to allow the least amount of temporary development with the least potential for adverse coastal resource impacts necessary to abate the identified emergency." Coastal Act section 30611 on emergency permits expressly states, "Nothing in this section authorizes permanent erection of structures[…]". The development is in no way temporary or consistent with the intention of emergency permitting provisions in the Coastal Act.

Second, the erosion event was by no means unexpected. Merriam-Webster's dictionary defines an emergency as "an **unforeseen** combination of circumstances or the resulting state that calls for immediate action." Sea level rise and increasing erosion are well known phenomena on the California coast and ample state level guidance exists on best planning practices. Erosion has been an issue at Surf Beach for many years. State Parks had every opportunity to develop a shoreline management plan for this park.

Instead, they waited until erosion was so acute that it constituted an "emergency" and took the easy way out by placing a revetment. This is, unfortunately, a pattern we've seen up and down California's coast: an emergency permit for armoring is granted, then extended despite conditions not being met. This leaves the public without a chance to provide input and with beaches that erode more quickly, ensuring that those beaches – and the waves associated with them – will be the first to disappear as sea levels continue to rise. Every decision the Commission makes on coastal armoring projects is a direct referendum on which beaches are believed worth saving from sea level rise and climate change hazards.

If State Parks and the Coastal Commission had acted rationally and implemented a temporary response to the erosion event, we would now be in the position of developing a well-thought out plan to address erosion at Surf Beach with meaningful public input. Instead, we are stuck with a course of action set into motion based on State Parks' short-sighted reaction. If removal of the revetment is not prudent given the permanent nature of the structure, there are nonetheless a number of measures that need to be included in coastal development permit number 9-19-0194 in order to ensure improved management and restoration of natural coastal processes in this unique and extremely popular portion of the California Coast.

Surf and Beach Erosion Monitoring

Surfrider appreciates the inclusion of surf and beach erosion monitoring in special condition 7 and 8. In order to capture meaningful data regarding the revetment's impact to surf over time, we suggest several modifications to the special condition.

First and foremost, due to the variability of surf on a daily basis, data collection two times per month is woefully inadequate. **Wave quality data should be captured at least two times per week in order to adequately represent conditions and changes to conditions overtime.** Other surf monitoring programs, including that at San Elijo Lagoon Restoration project required twice weekly monitoring. The Regional Beach Sand Project II (RBSP II) surf monitoring program in San Diego included daily surf monitoring. Given the potential for serious surf impacts over time, twice weekly monitoring over the lifespan of the revetment at Surf Beach is an extremely reasonable frequency.

In addition to the wave quality parameters listed, **the condition should also include capturing data on breaker distance from shore, length of peel, existence of backwash and density of surfers. Data should also include daily observations of whether the mean high tide line reaches the toe of the revetment.** This data will be crucial to evaluating surf and beach erosion impacts from the revetment and monitoring backwash conditions over time. This parameter has been used in other coastal development permits, including for a seawall at Strands Beach in Orange County. Ideally, standardized interviews with surfers using a questionnaire will also be conducted.

The Coastal Commission should set up a portal where the public can submit comments and photographs on surf quality and beach erosion. These comments should be incorporated into an annual monitoring report, available for public review and submitted to the Executive Director for approval. Currently, the special conditions only require one monitoring report submitted to the Executive Director near the end of the 5-year authorization. This will not give the public adequate opportunity to review trends, provide input and feedback or allow for State Parks to modify their course of action and plan for increasing erosion or revetment impacts in a meaningful timeframe.

<u>Long Term Hazard Management Plan</u>

Surfrider appreciates the 5-year limited authorization and requirement for development of a long-term hazard management plan in special condition 1(c). The condition requires evaluation of alternatives to the existing shoreline protective device and a proposal for mitigation for the effects of any remaining portion of the shoreline protective device. Surfrider supports this condition, however, would like to see the hazard mitigation plan incorporated into a larger shoreline management plan for Surf Beach.

Page 19 of the staff report states that, ""Given the impacts of shoreline protection and expectation of sea level rise and increased rates of erosion, **a long-term management plan that does not rely on hard shoreline protection would be the preferable approach**. There is an existing bluff top parking lot owned by the United States Marine Corps and leased to and operated by SONGS above the State Park. This site clearly represents the best opportunity to relocate the parking and public access from the beach" [emphasis added]. The staff report acknowledges that a long-term management plan is needed, but does not specifically require one in the conditions. **Surfrider requests clarification that a long-term management plan is expected in order to fulfill the requirements in special condition 1.**

Indeed, the entire beach is currently experiencing acute erosion and in clear need of a stepwise plan. Without a plan that clearly lays out short, medium and long term erosion control measures, it is highly likely that State Parks will again wait until an "emergency" and propose additional hard armoring structures in lieu of meaningful planning. **A plan with available short- and medium-term contingency erosion responses that avoids additional hard armoring along the remainder of Surf Beach is vital to protecting surf and sand supply. This plan should also evaluate availability of additional blufftop parking and construction of an access stairway or trail.** Additional parking options should be made available in a phased approach. This will allow natural coastal processes to take place with the least amount of impact to surf over time given sea level rise and increasing erosion. The plan should also include a sediment budget analysis in coordination with the San Diego Regional Sediment Management Working Group.

Finally, and importantly, the plan should be developed with stakeholder input and through a series of public workshops. Surfrider is willing to work cooperatively with State Parks to seek financial resources to fund these efforts. Workshops must include an educational component that explains advantages and disadvantages of each erosion management option and especially the negative impacts of hard armoring.

We don't have to imagine what Surf Beach might look like fully armored – proof exists just to the south at the San Onofre Nuclear Generating Station with a sandy beach has long been gone. Historical aerial photographs show the beach was once wide just like Surf Beach.

State Parks and the Coastal Commission still have the opportunity to make Surf Beach a shining example of a coastal adaptation project. State Parks could work cooperatively with other state agencies and the local community to seek funding and input to make this beach resilient to future conditions as has been done at Surfer's Point in Ventura and in Cardiff-by-the-Sea with the Cardiff Reef Living Shoreline.

Surfrider welcomes the opportunity to partner in support of smart planning at San Onofre State Beach rather than opposed to fighting future seawalls as erosion continues to increase. We still have the chance to save Surf Beach – whether or not the political willingness exists to do so is the only question that will decide the fate of the beloved beach.

Thank you for your consideration of our comments. We look forward to continue to work together toward smart planning and management at San Onofre State Beach.

Sincerely,

A. Sackett

Mandy Sackett
California Policy Coordinator
Surfrider Foundation

P.O. Box 73550, San Clemente, CA 92673 | info@surfrider.org | 949.492.8170 | surfrider.org