San Clemente Shoreline Feasibility Study
Orange County, California

Final Report

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

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ADDENDUM
San Clemente Shoreline Feasibility Study
Orange County, California

Final Feasibility Report and EIS
February 2012

1 PURPOSE

The purpose of this Addendum is to document changes to the project costs as presented in the Final Feasibility Report of July 2011, based on revision of the final project costs to reflect an increase in the physical monitoring costs and the current interest rate (Fiscal Year 2012) of 4 percent. The Cost Engineering Directory of Expertise (Cost-DX) certified the cost estimate in February 2011 at the October 2011 price level. The July 2011 report presented cost levels in January 2011 price levels, which were a part of the certified cost estimate. The Cost-DX has reviewed the updated cost estimate, with the above mentioned revision, and have stated that the changes are justified.

2 PHYSICAL MONITORING

Based on the condition, shown below, imposed by the California Coastal Commission's Coastal Consistency Determination and accepted by the Corps, the cost of the physical monitoring of the project during the 50-year period of analysis was increased from $856,000 to $950,000 for each nourishment cycle (approximately a 6-year period). This resulted in an overall increase to the total project cost of $2,100,000 (October 2011 price level). It should be noted that the majority of the physical monitoring costs were originally anticipated, however, the level of detail requested by the Coastal Commission exceeded initial estimates.

Condition #4:

*4. **Surfing Monitoring Details.** The Corps will revise its Surfing Monitoring Plan (Exhibit 15) to include and implement the following features:*

(a) adequate baseline data collection, including, if feasible, a full year of pre-construction monitoring to determine the baseline condition (conditions at the project area and, as appropriate, at control sites).

(b) identification of locations to be monitored, the length of the pre-project monitoring, and interest groups to be involved in establishing the monitoring effort to identify surfing or surf quality changes that might be attributable to the nourishment project, including identifying criteria for a determination of what constitutes a significant alteration or impact. Another location within the region might also be chosen to act as a control site to help determine if there are changes within the region to surfing conditions that could be attributable to other factors other than project implementation.

(c) supplementing the "wave observation" component of the surf monitoring with observations about the surfing activities, including a usage scale of surfers in the water, both morning and mid-day, and describing the average and maximum ride lengths.

(d) given that video recordings are included, if observer counts are too difficult for one observer, video may be used to augment observer counts.

(e) when collecting user data, the analysis should be disaggregated into weekday and weekend data.

(f) for mid-day observations on days when surfers are kept out of the water by lifeguards, these should be recorded as restricted use days (not zero use days).

(g) establishing mechanisms for informing the local community about the project, and encouraging public comments on surfing quality (or other recreational concerns), including but not limited to: (i) a web site, (ii) pre-construction notifications to the public; and (iii) signs.

To continue to work cooperatively throughout the final project planning and construction phases, the Corps will provide, prior to commencement of construction, a copy of the final monitoring plan, to the Commission's Executive Director, for his review. The Corps will carefully consider all comments by the Commission's Executive Director and will make all reasonable efforts to ensure that the concerns expressed are resolved prior to each construction phase.

3 BENEFITS UPDATE

The benefits of the project were recalculated using the FY12 discount rate of 4-percent. This resulted in an increase of net annual benefits from $901,000 to $978,000. There was not a change to the benefit to cost ratio.

4 UPDATED COST TABLES

The following table is an update of Table 6-4, displaying the costs of the plan at October 2011 price levels.

Federal and Non-Federal Initial Costs of the Recommended Plan
October 2011 Price Levels

		Non-Federal		Federal	
	Total Cost	**%**	**Cost**	**%**	**Cost**
Cash	**$11,300,000**		**$3,950,000**		**$7,350,000**
Real Estate (LERRDs)	**$11,000**		**$11,000**		
Cost Share: First Costs	**$11,300,000**	**35**	**$3,960,000**	**65**	**$7,350,000**
Cost Share: Continuing Construction	**$86,800,000**	**50**	**$43,400,000**	**50**	**$43,400,000**

The following table is an update of Table 6-5, displaying the fully funded cost estimate for the plan.

Federal and Non-Federal Cost Apportionment for the Total Project
Fully Funded Cost Estimate

Item	Total Project Cost	Non-Federal Cost	Federal Cost
Initial Construction			
Cash	$11,300,000	$3,950,000	$7,350,000
Non-Federal LERRD's	$11,000	$11,000	
Total Initial Cost	$11,300,000	$3,960,000	$7,350,000
Total Continuing Construction Cost (not discounted)	$150,000,000	$75,000,000	$75,000,000
Total Project Cost	$161,000,000	$78,900,000	$82,100,000
Percentage Share		49	51

5 UPDATED RECOMMENDATIONS

The information contained in this Addendum presents changes to the cost estimate and benefit calculation to reflect FY2012 price levels. These are the only changes to my original recommendation that was presented in the report dated July 2011. These recommendations still reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be further modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

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SAN CLEMENTE SHORELINE FEASIBILITY STUDY FINAL REPORT

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EXECUTIVE SUMMARY

Introduction

The San Clemente Shoreline Feasibility Study area is located along the Pacific Ocean coastline in the City of San Clemente, Orange County, California. San Clemente is the southernmost city in Orange County and is bounded by the Camp Pendleton Marine Base and San Onofre State Beach Park to the south; and to the north, by the communities of Capistrano Shores and Dana Point. The original total study area encompasses the City of San Clemente and extends from San Mateo Point, located at the southern boundary of the City, to Dana Point Harbor for a total distance of approximately 12.1 kilometers (7.5 miles).

Running along the entire length of the San Clemente shoreline is a portion of the LOSSAN (Los Angeles to San Diego) railroad corridor, which is owned by the Orange County Transportation Authority (OCTA). This commuter rail corridor is among the busiest in the country and separates the beach from the bluff. The study area is divided into ten reaches based on locations of developments and the condition of the revetment that runs along various stretches of the railroad tracks. After analysis of each section it was determined that only reach 6 of the original ten reaches has the potential for a justified project based on economic analysis. Reach 6 extends from Paseo de Cristobal to Linda Lane in the City and contains beaches ranging from 0 to 39 m (0 to 128 ft) in width measured from the project baseline (seaward rail of the railroad) to the beach berm. Reach 6 contains both the San Clemente Pier and the “T-Street Reef” and its beaches are backed by park facilities, railroad tracks, and high coastal bluffs. No protective revetment is present in Reach 6 and, in general, the majority of significant structures running along the beach are included in Reach 6.

The “T-Street” region of the shoreline is a notoriously popular surfing site located immediately south of the San Clemente Pier, and directly offshore of the T-Street overpass. The T-Street surf break is due to a permanent, hard bottom reef that rises above the seabed. As stated above, both the “T-Street Reef” and the Pier lie within the boundaries of Reach 6. It has become apparent through the study and through interaction with local conservation agencies (i.e. Surfrider), that the unique surfing characteristics in this area could be altered by modification to or burial of the reef. As a result, mitigation of impacts to the reef has become the largest constraint in the plan formulation process for this study. Other constraints include environmental effects including kelp, seagrass, and shallow water rocky habitat.

The purpose of this study is to identify the most technically feasible and economically beneficial “recommended plan” for reducing damages from storm-induced wave attack which are expected to increase, in the future, as a result of chronic, long-term shoreline erosion. Of great risk is the LOSSAN rail line, which runs close to the shoreline in much of the study area and in some areas is protected only with unimproved ballast and therefore vulnerable to storm-induced damages. The reconnaissance phase of this study was initiated on March 28, 2000 under the authority of Section 208 of the Flood Control Act of 1965. This phase of the study resulted in the finding that there was a Federal interest in continuing into the feasibility phase. The City of San Clemente, the non-Federal sponsor, and the U.S. Army Corps of Engineers (Corps) initiated the feasibility phase in September 2001. The feasibility phase study was cost-shared equally between the Corps and the sponsor.

Without-Project Conditions and Damages

Prior to urban development in the 1990's, the beaches within the study area remained relatively stable because of a balanced sediment supply delivered from the San Juan Creek to the Oceanside littoral cell. However, documented historical beach widths above the Mean Sea Level (MSL) line between T Street and Mariposa Point were as narrow as 25 m (82 ft) in the winter months during this time period (USACE-SPL, 1991). As a consequence, storm damages occurred in the past (e.g. 1964, 1983, 1988 and 1993), as the protective buffer beach width was narrow, particularly in the winter season.

Since the 1990's, the project area has experienced chronic, mild, long-term erosion. Shoreline retreat is a result of the decrease of fluvial sand supply resulting from the concreting of creeks and rivers, upstream dams, and urban development. Continued future shoreline retreat is expected to result in storm waves breaking directly upon the railroad ballast, which significantly threatens the operation of the rail corridor. Continued future shoreline retreat also will subject public facilities to storm wave-induced damages. These facilities, maintained by the City of San Clemente, include the Marine Safety Building, public restroom facilities located on the beach, lifeguard stations, parking areas, and paving near the Pier.

If no action is taken, public properties and structures are expected to be susceptible to damages caused by erosion (including land loss and undermining of structures), inundation (structures), and wave attack (structures, railroad).

Railroad Damages

The LOSSAN railroad line, separating the active coastline from the coastal bluff and adjacent backshore development, has experienced railway traffic service delays as a result of the narrowing shorelines. These delays occur when storm wave run-up exceeds the elevation of The Southern California Regional Railroad Authority (SCRRA) protective revetments or the crest of the railroad ballast in the without-revetment segments. Two service disruption incidents of approximately 24 hours occurred in the 1960's and 1970's (McGinley, 2003) at Mariposa Point (north of the Pier) and at a location south of the Pier, respectively.

In response, the SCRRA and OCTA have constructed un-engineered riprap revetment in areas where the railroad ballast and tracks are vulnerable to storm wave-induced damages, costing the SCRRA an average of between $200,000 and $300,000 over every three-year period. Over the past ten years, storm wave attack in the study area has restricted train services periodically and during the 1998 El Nino, the protective revetment structure sustained severe damage that significantly slowed train speeds.

Coastal Storm Damages

Public beach facilities located in Reach 6 have experienced damages from storms, as the existing beach has historically acted as a buffer against storm wave attack but has been narrowed. These facilities include the Marine Safety Building, public restroom facilities located on the back beach, lifeguard stations, parking areas, and paving near the Pier. The 1983 El Nino storm season resulted in an estimated damage of $3,277,000 to public beach facilities in the study area.

If no action is taken, the City of San Clemente's properties and structures will be susceptible to future damages caused by erosion (including loss of land and of properties), inundation, and wave attack. The majority of the National Economic Development (NED) damages/costs are related to LOSSAN railroad protection/construction and O&M costs. On an annual basis, the LOSSAN costs are $1,280,000 and the annualized value of all damage is $1,424,000. Throughout the San Clemente Study Area, the beach will continue to narrow under the without-project conditions, leading to a decline in recreational value as well.

Plan Formulation Process and Alternatives Considered

A broad set of project alternatives was initially considered:

1. No Action Alternative ("Do-Nothing");
2. Managed Retreat;
3. Beach Nourishment;
4. Revetment;
5. Seawall;
6. Groin;
7. Visible Offshore Breakwater; and,
8. Submerged Reef.

After reviewing the possible alternatives, only beach nourishment was identified as being suitable. All other alternatives were dropped from further consideration because of cost, ecosystem impacts, or lack of support from the local sponsor. The table below provides the levels of acceptability of the management measures on a qualitative scale. As can be seen in the table, only beach fill is both economically feasible and potentially environmentally acceptable. Detailed discussion of the screening of these alternatives is provided in Section 4.6.

Management Measure	Meets Purpose and Need	Technically Feasible	Economically Feasible	Environmentally Acceptable	Acceptable to Public
Beach fill	Yes	Yes	Yes	Yes	Maybe
Managed Retreat	Maybe	Yes	No	No	Maybe
Revetment	Maybe	Yes	Maybe	No	No
Seawall	No	Yes	Yes	No	No
Groin	Yes	Maybe	No	No	No
Visible Offshore Breakwater	Maybe	Yes	No	No	No
Submerged Reef	Maybe	No	No	Maybe	Maybe

The final recommended beach nourishment plan was developed by considering the storm damage reduction and recreational potential of various beach fill configuration alternatives and optimization of the average annual benefits they would yield. Beach widths ranging from 0 to 60 m (0 to 197 ft) were analyzed, with 15 m (50 ft) being designated as the NED Alternative, the alternative that would yield maximum benefits to the nation.

The following table summarizes the NED Plan costs and unlimited benefits. Initial Construction Cost consists of IDC, PED, S&A, and Environmental Monitoring Costs in addition to Initial Sand

and Initial Mob/Demob Costs as shown below. Annual Costs are the Total Cost-Shared Life-Cycle Costs of the project in Average Annual Value terms and the B/C unlimited ratio contains an unlimited amount of recreational benefits whereas the limit for recreational benefits used to calculate the limited B/C Ratio is 50% of the total benefits (i.e. 50% storm damage reduction benefits and 50% recreational). The results presented below are in January 2011 price levels and are based on a risk-based cost analysis (presented in detail in the Cost Engineering Appendix) and contain a 36% contingency.

Description :	**NED Alternative 2**
Initial Sand Cost	$5,250,000
Initial Mob/Demob	$2,890,000
Initial Construction Cost	$11,100,000
Annual Costs	$2,140,000
Annual Net NED Benefits (unlimited)	$901,000
B/C Ratio (SDR Benefits only)	0.7
B/C Ratio (unlimited)	1.4
B/C Ratio (limited)	1.3

The design berm elevation for the study is +5.2 m MLLW (+17 ft), which matches the natural berm of adjacent healthy beaches established by numerous surveys over the years (based on historical surveys). The design foreshore slope is established at 8H:1V and the construction foreshore slope is 13H:1V.

The recommended plan will require approximately 192,000 m^3 (251,000 CY) of beach compatible sand, placed by hopper dredge. The sand will be taken from a designated borrow site at Oceanside, CA and hauled 30 km (18.6 miles) to San Clemente. Roughly 1,040 m (3,412 ft) of shoreline would be nourished under this plan. The southern limit of the proposed beach fill is located immediately south of the T-Street overpass and the northern limit immediately north of the Marine Safety Headquarters, which lies in Reach 6. A taper would continue an additional 100 m (330 feet) to the north and south to merge with the existing shoreline.

The effects of the recommended plan on the existing surfing characteristics of the study area are not quantifiable but are not expected to be large. While the potential for negative impacts on surfing exist, the equilibration footprint of the recommended plan is not expected to encroach greatly on the reef nor modify the wave-refracting qualities of the reef. In addition, it is estimated that no more than roughly 15% of the reef (all on the landward side) would potentially be impacted or buried by the NED Plan, thus potential impacts on surfgrass and rocky reef resources are expected to be minimal. Re-nourishment would be performed every 6 years. The figure below shows the reef and associated resources in relation to the equilibration footprint of the 15-m NED Plan which spans the extent of Reach 6.

USACE policy requires that a range of possible sea level rise scenarios. Over the 50 year time period between 2012 and 2061, the relative sea level rise in San Clemente, using historic data, is expected to be 0.12 m (0.4 ft) and, using the high scenario, is predicted to be 0.7 m (2.3 ft). The recommended plan is formulated on the basis of continuous monitoring of beach fill erosion and renourishment. This monitoring should identify any rapid change in sea level. A higher future sea-level rise increases the potential for storm damages. A comparison of the number of fills required over the 50-year period of analysis shows 9 fills, including initial placement, needed for the historic sea level rise and 10 needed for the high sea level rise curve. These results indicate that the recommended plan is functional in a range of sea level rise scenarios with monitoring, and unlikely to carry a significant degree of risk related to sea level rise.

Sufficient parking and public access is provided to the project area. Of the current demand for parking spaces of almost 1100, there are almost that same number of spaces available within a 5-minute walk to the beach and even more spaces available if the distance is extended to 0.8 km (0.5 mi). There are 4 access points to the beach within the project area and one just north of the project area.

As stated, the average annual cost of the plan is $2,140,000. Initial construction will be cost-shared 65% Federal and 35% Non-Federal and continuing construction (i.e. each renourishment and monitoring) will be cost-shared 50%-50%. Based on January 2011 price levels, the estimated total first cost of the plan is $11,100,000. Continuing construction will consist of 8 renourishments with a total continuing construction cost estimated to be $84,900,000 over the 50-year period. The sum of the first cost and periodic nourishments is estimated to be $96,000,000. The City of San Clemente has expressed their interest in providing the Non-Federal matching funds to implement and construct the recommended plan.


T-Street Reef Resources and
NED Plan Footprint in Reach 6
LEGEND
Construction Footprint
Equilibration Footprint
T-Street Surfing Area
Downcoast Surfgrass (T-Street Reef)
Kelp Bed (Surveyed 7-15-09)
Meters
0 50 100 200 300 400
N

1 INTRODUCTION

1.1 Study Authority

This report was prepared as a response to the study authority in Section 208 of the Flood Control Act of 1965 (Title II of Public Law 89-298), which reads:

> *"The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the localities specifically named in this section. … Coasts of Washington, Oregon, and California to determine advisability of protection work against storm and tidal waves."*

Funding was initially appropriated by the Energy and Water Development Appropriations Act of 2000, Public Law 106-60, for the reconnaissance study, as recommended in House Report 106-253, page 27:

> *"The Committee recommendation includes funds for the Corps of Engineers to conduct a reconnaissance study investigating shoreline protection alternatives for San Clemente, California."*

The reconnaissance phase of the study was initiated on March 28, 2000. This phase of the study resulted in the finding that there was a Federal interest in continuing the study into the feasibility phase. The City of San Clemente as the non-Federal sponsor and the U.S. Army Corps of Engineers (Corps) initiated the feasibility phase of the study in September 2001. The feasibility phase study cost was shared equally between the Corps and the sponsor. This report presents the preliminary results of both phases of study.

1.2 Study Purpose and Scope

The purpose of this Feasibility Study is to:

1) Describe existing and future without-project conditions along the coast of the City of San Clemente in Orange County, CA and identify problems and opportunities to reduce storm damages, improve public safety, increase recreation opportunities, and protect the environment.

2) Formulate and evaluate an array of alternatives and recommend the one that most effectively addresses these problems and complies with local, state, and Federal laws and regulations. Four accounts, National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE), are used to evaluate the plans.

1.3 Planning Process and Report Organization

This report includes the alternatives analysis, which develops options that focus on the reduction of storm damages. The alternatives are evaluated, and preliminary recommendations are made. This feasibility study was conducted in accordance with current Corps of Engineers regulations and policies including, but not limited to the Principles and Guidelines for Water Resources and ER 1105-2-100, Planning Guidance notebook (22 April 2000), Guidance for

Conducting Civil Works Planning Studies, (Dec 1990). The six steps in plan formulation, which are expanded in the aforementioned documents, are listed below and discussed further in Chapter 6, Plan Formulation.

1) Identify Problems and Opportunities
2) Inventory and Forecast Conditions
3) Formulate Alternative Plans
4) Evaluate Alternative Plans
5) Compare Alternative Plans
6) Select a Recommended Plan

1.4 Study Participation, Public Involvement and Coordination

The non-Federal sponsor of this study is the City of San Clemente whose representatives have taken an active role in support of this study. Numerous local, state, and federal agencies were also involved in the study effort, and these are listed below. This Feasibility Study is funded with 50% Federal and 50% non-Federal funds.

A major consideration for the City of San Clemente and the Corps of Engineers in formulating and selecting a recommended plan is consideration of the acceptability of the plan to public interests. The study included several public involvement activities to allow for public interests to provide input, and their views and comments on the study area, conditions, problems, and needs, alternative plans, and the selected recommended plan. The public involvement activities and views and comments received are presented in Chapter 7 of this report as well as the Coordination Chapter of the EIS/EIR.

The Cooperating/Consulting Public Agencies and Institutions that participated in the San Clemente Shoreline Feasibility Study include:

Federal Agencies
U.S. Coast Guard
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. National Marine Fisheries Service
State Agencies
California Coastal Commission
California Department of Fish and Game
California Department of Boating and Waterways
California Regional Water Quality Control Board
Office of Historic Preservation
Local Agencies
City of San Clemente
South Coast Air Quality Management District
Southern California Regional Railroad Authority (SCRRA)
Orange County Transportation Authority (OCTA)
Metrolink

1.5 Prior Studies, Reports and Existing Water Projects

There are no existing Federal Shore Protection Projects in the Study area. The following reports are being reviewed as directed in the study authorization:

1. *State of the Coast Report, San Diego Region, River Sediment Discharge Study Report*, Corps of Engineers, 1988. This report presents the findings of a study estimating the sediment delivery to the coast from streams and watersheds draining to the California Coast in the San Diego Region, which extended north to the Dana Point headlands. It concludes that 90% of the average annual yields of sands came from major rivers and the other 10% yielded from coastal streams.

2. *State of the Coast Report, Coast of California Storm and Tidal Wave Study, San Diego Region, Littoral Zone Sediments Report*, Corps of Engineers, 1988. This report presents the findings from the collection, analysis, and interpretation of sedimentologic data from the littoral zone. From the findings, littoral segments along the southern California coast and the most likely transport direction within each of these littoral segments are defined.

3. *State of the Coast Report, San Diego Region, Historic Wave and Sea Level Data Report*, Corps of Engineers, 1988. This report presents statistically analyzed historic wave data and recent wave hindcasts for Southern Hemisphere swells and tropical storms that have impacted the San Diego region. The tide regime, historic and predicted extremes of sea level, and a chronology of extreme storm events are also presented.

4. *State of the Coast Report, Coast of California Storm and Tidal Wave Study, San Diego Region, Main Report*, Corps of Engineers, 1991. This report suggests that the condition of the beaches in the future will be governed by cycles of accretion and erosion similar to those of the past 50 years, but with accelerated trends toward erosion because of the reduction in fluvial delivery due to impediment by dams and river mining, the influence of Oceanside Harbor interrupting alongshore sediment transport, and the increasing rate of sea level rise.

5. *Wave Information Studies of US Coastlines, Southern California Hindcast Wave Information*, Corps of Engineers, 1992. This report presents hindcast wave information from 1956 to1975 for the region south of Point Conception to the Mexican border. The sources of wave energy and local effects that control the wave climate included in this report consists of northern Pacific swell, east Pacific wind fields and associated waves, localized effects such as sheltering and diffraction by islands, and meso-scale meteorological systems such as land-sea breezes.

6. *Strategic Rail Corridor Network (STRACNET) and Defense Connector Lines*, Military Traffic Command, Transportation Agency, 1998. This study updates the designation of the Strategic Rail Corridor Network (STRACNET) and its associated connector lines to verify that the rails meet defense readiness requirements for maintenance condition, clearance, and gross weight capability. STRACNET maintains a rail line running parallel to the coastline throughout the City of San Clemente.

7. *Oceanographic Design Conditions for the Repair of the San Clemente Pier*, Moffatt & Nichol Engineers, 1983. This report documents oceanographic data from the 1982-1983 winter storms, which destroyed approximately 134 meters (440 feet) of the San Clemente Pier. Design suggestions from this data and previous storm data are proposed for the repair of the Pier.

8. *Beach Width and Profile Surveys,* City of San Clemente, 2000 & 2002. Results of beach width measurements taken by the City at 16 locations in 1958, 1981 and 1999 are presented. Also, results of benthic elevations along the Pier from 1981 to the present are

provided. The data indicates that there has been a significant increase in the loss of sand along the City's coastal stretch.

9. *Draft Mitigated Negative Declaration, Marblehead Coastal Beach Replenishment Project,* City of San Clemente, 2000. This CEQA document describes a private beach nourishment project along the San Clemente shoreline.

2 STUDY AREA

2.1 Location and Description

The San Clemente Shoreline Feasibility Study area, as presented in **Figure 2-1**, is located along the Pacific Ocean coastline in the City of San Clemente, Orange County, California. San Clemente is the southernmost city in Orange County and is bounded by the Camp Pendleton Marine Base and San Onofre State Beach Park to the south; and to the north, by the communities of Capistrano Shores and Dana Point. The total study area encompasses the City of San Clemente and extends from San Mateo Point, located at the southern boundary of the City, to Dana Point Harbor for a total distance of approximately 12 kilometers (7.5 miles).

The City of San Clemente's shoreline has narrow sandy beaches, on the order of 0 to 40 meters (0 to 130 feet) from baseline to berm, and is backed by high coastal bluffs and pockets of coastal development and infrastructure. The gently to moderately sloping sandy beaches grade into a foreshore consisting of gravel and cobble at the water line in several locations. Running along the entire length of the study area is a major railroad corridor linking the coastal communities of southern California to the greater Los Angeles and San Diego metropolitan areas. The Southern California Regional Railroad Authority (SCRRA), a public associated agency, operates this corridor, which is one of the busiest in the nation. The railroad is constructed on conventional elevated crush rock ballast and is a prominent feature within the study area and effectively separates the beach area from the coastal bluffs. Historically, riprap has been placed along the seaward side of the corridor to protect the rail line from storm wave attack. The existing railroad revetment provides varying levels of protection depending on the rock size and conditions of the riprap for both the rail line and development and infrastructure improvements landward of it.

Figure 2-1 Study Area Reach

2.1.1 Reach Boundaries

To better analyze the interaction between the coastal bluffs, the railroad corridor and the shoreline morphology, the entire study area was divided into ten reaches (as shown in **Figure 2-1**). The primary consideration for project reach delineation was the varying methods of construction employed by SCRRA to protect the railroad. Armoring varies from conventional rock ballast construction to improved armor stone protection. A secondary consideration for the distinction between reaches was based on differences in topography, coastal development and beach conditions.

The 10 reach boundaries, as described in **Table 2-1**, are defined in meters northward from San Mateo Point (Station 0+000) and shoreline features located within each reach are described. Since the railroad is assumed to be a constant feature throughout the 50 year period of analysis, the railroad tracks provided a convenient feature to define a horizontal alignment. Boundaries for reaches 1 through 8 were based on whether an engineered revetment or railroad ballast exists along the railroad tracks. The reaches that have a revetment to protect the railroad are sub-divided into cells with a length of 50 meters (164 feet). Reaches 9 and 10 are located north of the city limits of San Clemente.

Table 2-1 Reach Boundaries

Reach	Range		Approximate Length m, (ft)
	From	To	
1	San Mateo Point	Palmeras	969 (3,180)
2	Palmeras	3800 Block, Vista Blanca	680 (2,230)
3	3800 Block, Vista Blanca	Calafia	600 (1970)
4	Calafia	Primavera	732 (2,400)
5	Primavera	Cristobal	413 (1,350)
6	Cristobal	Linda Lane	1,040 (3,410)
7	Linda Lane	1200 Block, Buena Vista	1,081 (3,550)
8	1200 Block, Buena Vista	Pico	347 (1,140)
9	Pico	San Andreas	1,101 (3,610)
10	San Andreas	Dana Point Harbor	5,000 (16,400)

Reach 1 (**Figure 2-2**) extends from San Mateo Point at Station 0+146 to Station 1+115, a distance of 969 meters (1,380 ft). This reach is the southern portion of San Clemente State Beach. Beach width, which is defined as that portion of the beach between the foreshore berm contour and a backshore baseline, is zero at the southern boundary and gradually increases to 41 m (135 ft) wide. For this study, the baseline is the seaward rail of the railroad. A revetment protects the seaward slope of the railroad and has a slope of 1H:1V, with a crest elevation of approximately +7 m (23 ft). There are no structures seaward of the railroad, however, some residential structures exist immediately landward of the railroad.

Figure 2-2 Reach 1

Reach 2 (**Figure 2-3**) extends from Avenida de las Palmeras (Station 1+115) to the 3800 block of Vista Blanca (Station 1+795), a distance of 680 meters (2,230 ft). This reach includes San Clemente State Beach and can be characterized as having a narrow to a moderate sized beach that is backed by the railroad corridor located at the base of high coastal bluffs. Beach width is approximately 40 m (130 ft) wide at the southern boundary and gradually decreases to 9 m (30 ft) wide. The railroad seaward slope is not protected by a revetment, but does contain conventional ballast construction, which has a slope of 1H:1V, and a crest elevation of approximately +6.4-7.6 m (21-25 ft). There are no structures seaward of the railroad; the underpass for San Clemente State Beach is included within this reach.

Figure 2-3 Reach 2

Reach 3 (**Figure2-4**) extends from the 3800 Block of Vista Blanca (Sta 1+795) to Avenida Calafia (Sta 2+395), a distance of 600 meters (1,970 ft). This reach encompasses San Clemente State Beach and Calafia Beach Park. The beach width is approximately 9 m (30 ft) wide at the southern boundary and quickly becomes zero throughout the remainder of the reach. There is a revetment protecting the railroad seaward slope, with a slope of 1H:1V, and a crest elevation of approximately +7 m (23 ft). There are no structures seaward of the railroad and Calafia Beach Park is on the landward side of the railroad.

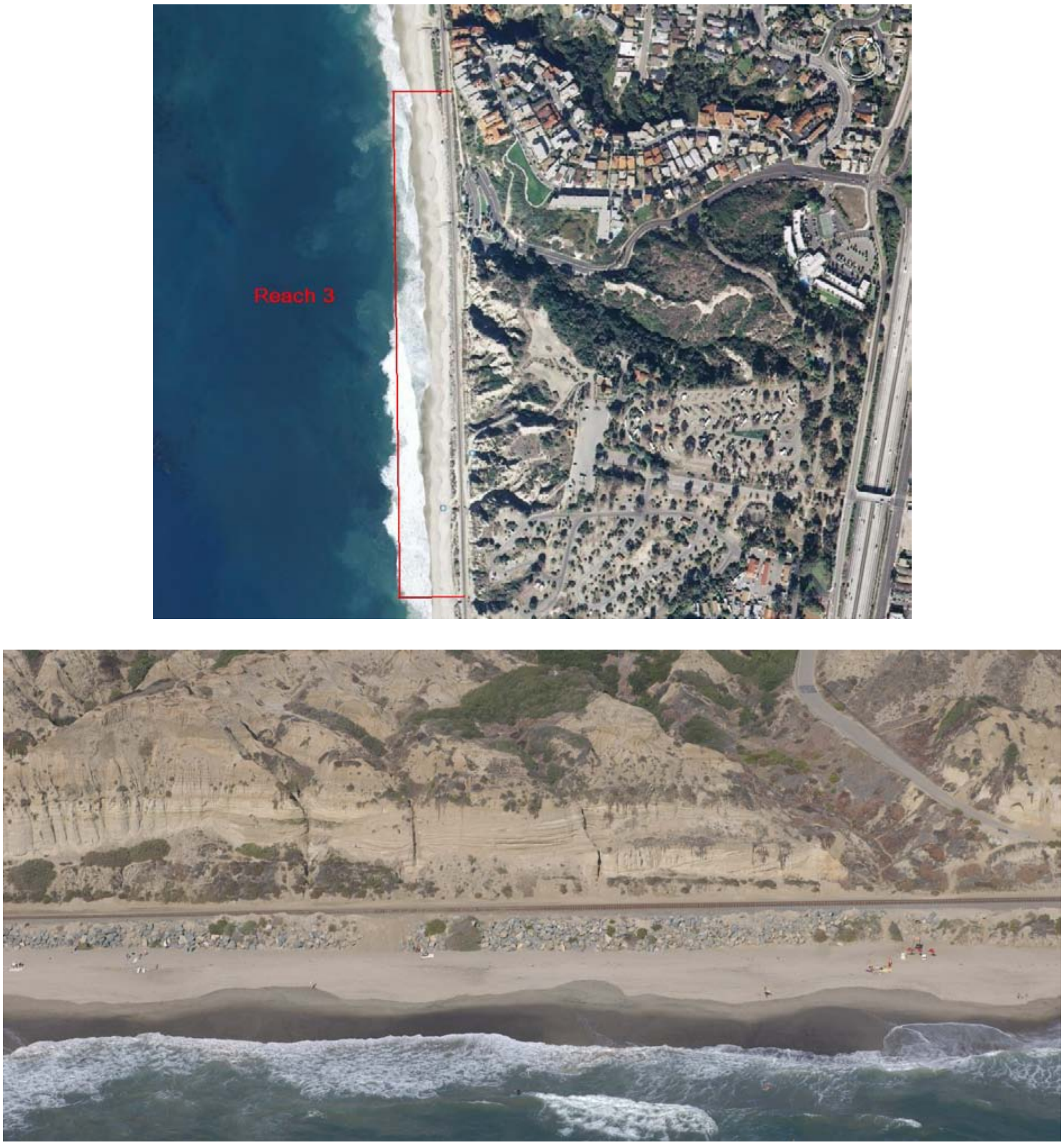


Figure 2-4 Reach 3

Reach 4 (**Figure 2-5**) extends from Sta 2+395 at Avenida Calafia to Sta 3+127 at Calle Primavera, a distance of 732 meters (2,400 ft). This reach encompasses San Clemente State Beach on the southern portion and the City of San Clemente on the northern portion. Beach width is approximately 30 m (98 ft) wide at the southern boundary, transitions to 60 m (196 ft) wide in the middle, and transitions to 10 m (33 ft) wide at the northern boundary. The railroad seaward slope is not protected by a revetment, but does contain conventional ballast construction, which has a slope of 1H:1V, and a crest elevation of approximately +6.3 m (21 ft). There are no structures seaward of the railroad, however, some residential structures exist immediately landward of the railroad.

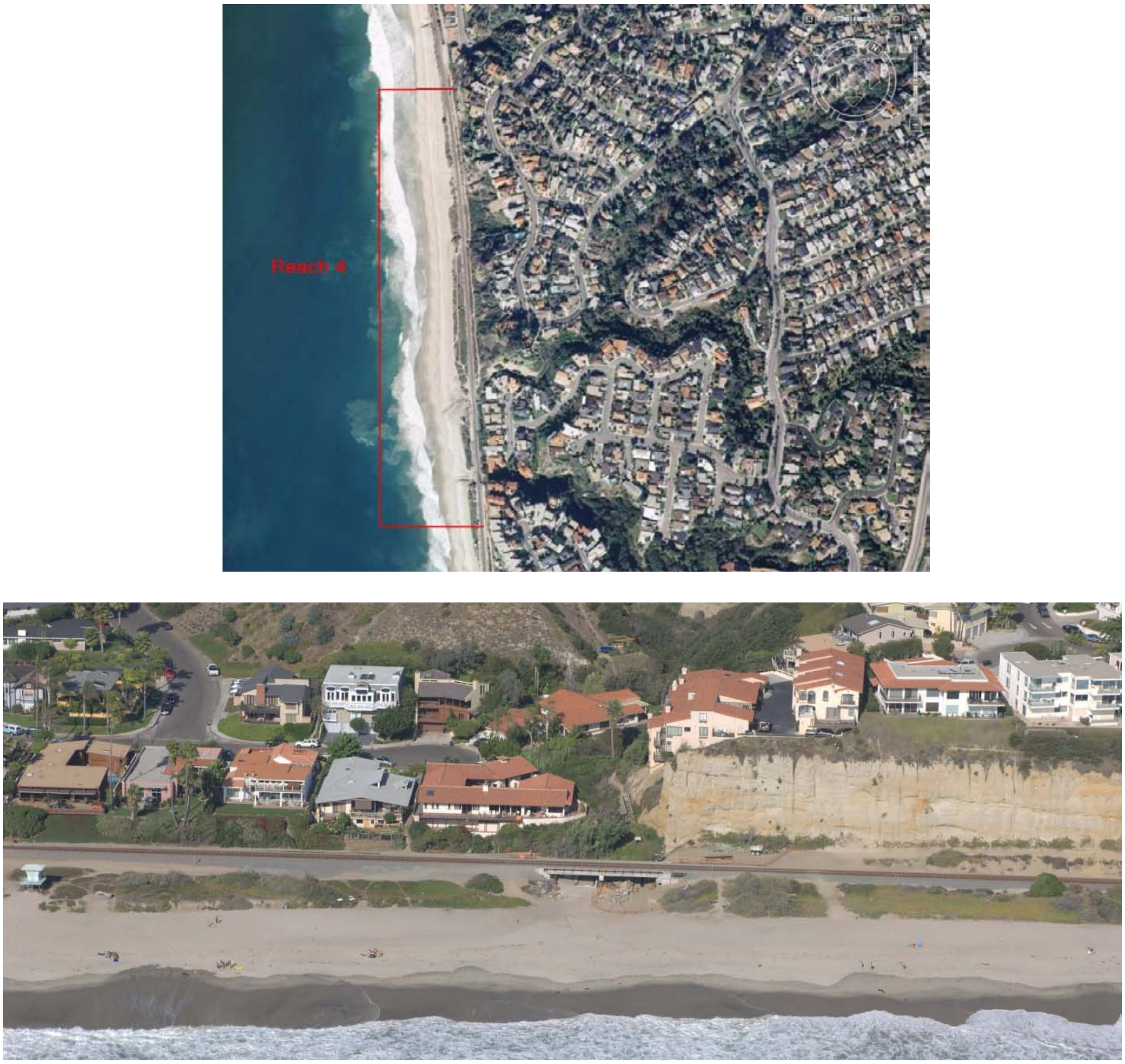


Figure 2-5 Reach 4

Reach 5 (**Figure 2-6**) extends from Sta 3+127 at Calle Primavera to Sta 3+540 at Paseo de Cristobal, a distance of 413 meters (1,355 ft). Beach width is 0 m wide throughout the reach. There is a revetment protecting the railroad seaward slope, which has a slope of 1H:1V, and a crest elevation of approximately +6.5 m (21 ft). There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad.

Figure 2-6 Reach 5

Reach 6 (**Figure 2-7**) extends from Sta 3+540 at Paseo de Cristobal to Sta 4+580 at Linda Lane, a distance of 1,040 meters (3,412 ft). Beach width meanders from 0 m wide to 23 m (75 ft) to 0 m to 39 m (128 ft) and back to 0 m along the reach. The beaches are backed by park facilities, railroad tracks, and high coastal bluffs. This reach includes the majority of the significant structures along the beach. This reach does not have an existing revetment to protect the railroad tracks, but does include the conventional ballast.

Figure 2-7 Reach 6

Reach 7 (**Figure 2-8**) extends from Sta 4+580 at Linda Lane to Sta 5+661 at the 1200 block of Buena Vista, a distance of 1,081 meters (3,550 ft). This reach contains “Mariposa Point,” which lies at the center of the reach and approximately 300 meters (985 ft) northwest of the San Clemente Municipal Pier. There is a revetment protecting the railroad seaward slope, which has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). The railroad track elevation is approximately +6.5 m (21 ft). Although coastal development and infrastructure exist atop the coastal bluffs, no structures exist either seaward or landward of the railroad corridor along the back beach zone. However, a pedestrian and railroad access dirt path is evident immediately adjacent to the tracks on the landward side throughout much of the reach.

Figure 2-8 Reach 7

Reach 8 (**Figure 2-9**) extends from Sta 5+661 at the 1200 Block, Buena Vista to Sta 6+008 at Avenida Pico, a distance of 347 meters (1,140 feet). This reach represents the area known as North Beach, located just south of Capistrano Shores, and varies in width from 40 m (130 ft) wide at the southern boundary to 0 m at the northern boundary. The railroad seaward slope is not protected by a revetment, but does contain conventional ballast construction, which has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). The railroad track elevation is approximately +6.3 m (21 ft). The concession and restroom facility for the north beach is located within this reach.

Figure 2-9 Reach 8

Reach 9 (**Figure 2-10**) extends from Sta 6+008 at Avenida Pico to Sta 7+109 at Via San Andreas, a distance of 1,101 meters (3,610 ft). This reach is known as “Capistrano Shores”, private community of manufactured housing constructed in the 1950’s. A timber seawall that is fronted by a rubble mound rock revetment protects the reach. The armor stone is estimated to be 2-5 tons, has a slope of 1H:1V, and a crest elevation of approximately +6.0 m (20 ft). General condition of the revetment is not uniform and appears to be fair/poor along the entire length. The beach width within this coastal zone may be considered to be primarily non-existent. The railroad is located substantially landward of the revetment and as such is no longer considered the project landward boundary. There are no structures seaward of the revetment.

Figure 2-10 Reach 9

Reach 10 (**Figure 2-11**) extends from Sta 7+109 at Via San Andreas to Dana Point Harbor, a distance of approximately 5,000 meters (3.1 miles). This reach is located immediately south of Dana Point Harbor and primarily encompasses residential coastal development along Camino Capistrano, public recreational vehicle camping and parking facilities, and Doheny State Beach and Park. The beach within this reach may be characterized as ranging between narrow to moderate in width and is backed by the aforementioned development, the railroad corridor, Pacific Coast Highway, and the coastal bluffs, respectively.

Figure 2-11 Reach 10

Reach Selection Criteria

Preliminary plan formulation and model development included the entire study area. During preliminary plan formulation it became evident that the majority of National Economic Development (NED) benefits would be derived from protection of the railroad line. Reaches 1, 3, 5, 7, and 10 were eliminated from further study due to the existence of an engineered revetment built to protect the railroad and Reach 9 was eliminated due to the engineered revetment constructed to protect the coastal property that sits landward of the railroad throughout the reach. Damages due to storms and existing erosion are not expected to greatly impact the railroad in these reaches.

The railroad in reaches 2, 4, 6 and 8 are currently protected by conventional ballast construction. Reaches 2 and 4 have beach widths greater, on average, than the other unprotected reaches. In addition, these two reaches also lack ocean-side development, further minimizing the potential for storm damage reduction benefits. Reach 8 is also unprotected by a revetment, however, the length of the reach, which was determined by the presence of engineered revetments to the north and south (Reaches 7 and 9), is too small for a justifiable project. Since the reach is so small (1/3 the size of Reach 6), initial model predictions indicate that a seawall should already be constructed prior to the start of our period of analysis.

Furthermore, the end losses (erosion) of a beach nourishment project would be too great for economic justification.

Reach 6, with the presence of public structures landward of the railroad, narrow beach widths, and presence of only conventional ballast for railroad protection, is the only reach carried forward for further alternatives analysis.

Reach 6

Coastal residential development, parks and public facilities, infrastructure and beach recreation are the most abundant within this reach. Some of these structures include the San Clemente Municipal Pier and underpass access, Marine Safety Building, public restrooms, picnic facilities and the T-Street overpass (see **Figures 2-12 and 2-13**).

The San Clemente Municipal Pier is located in the northern half of the reach and was originally constructed around 1928. In its current state, the Pier is approximately 390 meters (1,280 feet) long and has a typical deck width of about 6.4 meters (21 feet) and a deck elevation ranging from +7.2 meters (24 ft), MLLW near the Pier head to +8.3 meters (27 ft), MLLW at the seaward end. A restaurant occupies the base portion of the Pier with three smaller structures; including a snack shop, watchtower, and restroom located further seaward. The landward portion of the Pier has timber piles, caps and decking while the seaward 134 meters (440 ft) of the Pier has been reconstructed with steel members as this portion of the Pier was destroyed by large swells on March 1-2, 1983 from an intense storm moving eastward from the central Pacific Ocean. This storm, which caused in excess of $2,100,000 in damage to the Pier, was one of a series of severe storms occurring during the winter of 1982-1983 causing extensive damages and warranting a major disaster declaration in many areas of the State of California. Development along the sloped bluffs adjacent to the Pier is founded on an ancient landslide.

The Marine Safety Building is located on the beach approximately 183 meters (600 feet) north of the Pier. The building, which is an approximate 465 square meters (5,000 square feet) single story timber frame structure, has been under increased risk due to wave attack. An extensive amount of sand that at one time provided a buffer between the waves and the building has since eroded away to the point where the piles that support the most seaward portion of the building are exposed. As a result, an emergency sheet pile wall has been placed in front of the building to help protect the foundation from wave attack.

Figure 2-12 Reach 6 Oblique Photos

Figure 2-13 Reach 6 Oblique Photos (continued)

2.2 Physical Characteristics

2.2.1 Topography

Terrestrial topographic data were obtained from March 2002 aerial LIDAR surveys conducted as a part of this study. LIDAR (LIght Detection And Ranging) is a state-of-the-art survey system that allows high-speed collection of topographic data. The system employs a helicopter-mounted range-finding laser that is coupled with a highly accurate GPS positioning system to collect precise GPS measurements, platform altitude, laser ranges, and imagery data. Topographic information was collected at horizontal point spacing on the order of 0.1 meter (0.3 ft) that allowed detailed information to be collected of the beach, revetment, railroad, and ground elevations adjacent to structures throughout the study area. In addition, detailed mapping in the damage/flood areas provided existing beach contours, beach widths, berm elevations, foreshore slopes, and the back beach horizontal position of coastal structures. The results of the March 2002 LIDAR survey and topographic mapping investigation are presented in Appendix D of the EIS/EIR.

2.2.2 Bathymetry

The bathymetry within the San Clemente project study area is presented in Appendix D of the EIS/EIR. The water depths in the survey area range from 3 meters (10 ft) near the beach to 23 meters (75 ft) offshore. The seafloor slope direction is southwest or normal to the beach. The seafloor gradient averages 0.9 percent but varies locally. The inshore gradient between the 3 to 6-meter (10-20 ft) water depths is approximately 5 percent in the San Clemente State Beach area and decreases in a northwestward fashion as one travels from San Mateo Point to Dana Point Harbor. Several bedrock spurs extend out from shore; the largest one is the seaward extension of San Mateo Point, which may rise several meters above the intervening swales. The San Mateo Rocks northwest of San Mateo Point are isolated and may be remnant spurs. Bedrock outcrops the seafloor in places between the shore and about the 15-meter (50 ft) isobath. Where outcrops occur, the seafloor is uneven from the resistant bedrock mounds. Some of the larger outcrops rise as much as 6 meters (20 ft) above the surrounding seabed. The gradients along some of these outcrop slopes can be as high as 33 percent (18^{o}). A smooth seafloor with an even slope forms the topography seaward of the outcrops. This smooth texture is a result of unconsolidated recent sediment deposition.

Side scan sonar data of the area, performed in May 2002, clearly show areas where bedrock is exposed. In several locations, survey data could not be acquired, as the kelp was too thick to navigate through. It is well established that bedrock is necessary for kelp growth. The bedrock exposures are mapped as either areas where exposures comprise greater than 50 percent of the seabed or zones where scattered rocks cover 10 – 50 percent of the area. Unconsolidated superficial sediment predominates in the scattered rock zones. The sub-bottom profile data reveal an immeasurably thin superficial veneer overlies the bedrock. This thin sand lens likely changes seasonally as beach sands migrate in a cross-shore direction.

2.3 Geologic Characteristics

The San Clemente area comprises a part of the western flank of the Peninsular Range Geologic Province of southern California and includes areas of the western foothills of the Santa Ana Mountains and the southeastern flank of the San Joaquin Hills. The Peninsular Range extends from the Palos Verdes Peninsula in the north to the tip of Baja California in the south. The bedrock exposure in the area is comprised of marine sedimentary and volcanic rocks of

Miocene, Pliocene and Pleistocene age. The bedrock formations both onshore and offshore consist of the San Mateo Formation, an arkosic sandstone of Pleistocene age, the Capistrano Formation, a series of silty shales, mudstones, siltstones and coarse sandstones of late Miocene and early Pliocene age and the San Onofre Breccia which is a series of volcanic breccias, ash flows and tuffs derived from large landslides during volcanic eruptions interbeded with layers of fine-grained volcanic ash deposited into fresh or salt water and is of Miocene age.

2.3.1 Onshore Geology

As result of marine erosion within the San Clemente Shoreline Feasibility study area, a broad wave-cut terrace has formed extending back from the coastline and lying several meters above sea level. This relatively flat surface is cut mainly in rocks of the Capistrano Formation of late Miocene and early Pliocene age and is mantled with poorly consolidated non-marine alluvial cover of Holocene and Pleistocene age and marine terrace deposits of Upper Pleistocene age. The non-marine cover consists of poorly bedded fine-grained sediments. The marine terrace deposits consist of poorly consolidated sands, sandstones and conglomerates. The beach, which begins at the foot of the wave-cut terrace, is composed of fine to medium grained sands and silty sands. Because of various seasonal cycles of sand deposition and erosion and the lack of adequate natural beach renourishment cycles in the area, the beach varies in width from roughly 0 to 60 meters (0 to 200 feet).

2.3.2 Offshore Geology

The area offshore of San Clemente is a part of the Capistrano Bight, located at the eastern edge of the Gulf of Santa Catalina. This area is described as that part of the California coast known as the “Continental Borderland”, as there is no real continental shelf in this part of the coast. The area from Dana Point Harbor in Orange County downcoast to La Jolla in San Diego County is further defined as the “Oceanside Littoral Cell”. The City of San Clemente’s shoreline is located in the extreme upper portion of this Littoral Cell.

The detailed local offshore site geology and bedrock location identification was determined by a seismic survey plus 10 vibracore test holes drilled and sampled at random locations offshore of the City of San Clemente. The seismic survey was accomplished during the summer of 2002 and the vibracore sampling was accomplished from December 2002 through January 2003. The bathymetric survey indicates that the ocean bottom slopes gradually seaward for a distance of about 1,500 meters (0.93 miles) from elevation 0 meter, MLLW at the shoreline to an elevation deeper than -32.8 meters (-100 feet), MLLW. The accompanying geophysical surveys further indicated that the ocean floor is a bedrock surface covered with a thin veneer of littoral sediments that vary in thickness from approximately 0 to 0.32 meters (1-foot) or more, out to a distance of about 1,500 meters (4,920 ft) from the shoreline.

2.4 Seismicity

The geologic structure of the San Clemente study area region is the result of faulting and folding in the current tectonic regime, which began approximately 5 million years ago when the Gulf of California began to open in association with renewed movement on the San Andreas fault system (Fisher and Mills, 1991). The tectonic forces are also evident in the localized folding and faulting of the Eocene-age sediments. Some of the faults locally control the contact between formations.

The study area is located within the moderately active seismic region of Southern California that is subject to significant hazards from moderate to large earthquakes. There are several northwest to southeast trending faults in both the onshore and the offshore areas east and west of San Clemente. The Whittier-Elsinore, Agua Caliente, San Jacinto and the San Andreas Fault zones are located approximately 32 kilometers (20 miles), 43 kilometers (27 miles), 64 kilometers (40 miles) and 100 kilometers (62 miles) northeast of San Clemente, respectively. The Newport-Inglewood-Rose Canyon Fault lies approximately 8 kilometers (5 miles) offshore of the beach. The Palos Verdes Fault zone parallels the Pacific Coast offshore from the San Pedro – Long Beach area to La Jolla and lies about 29 kilometers (18 miles) from the coastline. The San Clemente Island Fault zone lies approximately 88 kilometers (55 miles) offshore and is parallel to the Newport-Inglewood-Rose Canyon Fault zone. These three faults trend parallel to the onshore faults. The Cristianitos Fault, which is the closest fault to the project area, trends northwest to southeast and passes through the mountain ranges behind the San Clemente area and then trends down the San Mateo Creek and goes offshore to parallel the coastline near San Onofre in a southerly direction past Oceanside. The fault is located approximately 2 to 8 kilometers (1 to 5 miles) offshore of the beach within San Clemente. Ground shaking resulting from an earthquake can impact the San Clemente study area.

There have been several landslides mapped in the hills and mountains that form the eastern boundary of the San Clemente project study area. These are shown on a geologic map accompanying "Natural Slope Stability as Related to Geology, San Clemente Area, Orange and San Diego Counties, California, Special Report 98" (Blanc and Cleveland, 1968) published by the California Division of Mines and Geology. The geologic map indicates that there are seven small areas of the bluff behind the beach extending from the San Clemente Pier to San Mateo Point, which contain landslide deposits. However, since none of these slides extend into the beach zone, they are not considered to be a potential problem for future beach nourishment efforts.

2.5 Climate

2.5.1 General Climatic Conditions

The local climate is dominated by the strength and position of the semi-permanent high-pressure center over the Pacific Ocean near Hawaii. This high-pressure center results in cool summers, mild winters, and infrequent rainfall. It also drives the cool daytime breezes resulting in comfortable humidity levels and an abundance of sunshine. Based on data obtained from the South Coast Air Quality Management District (SCAQMD) coastal Orange County temperatures average 61°F with an average summer temperature ranging from 68 to 70°F and an average winter temperature ranging from 51 to 53°F. Rainfall averages about 0.3 meter (12 inches) per year in the coastal zones. In contrast to a very steady pattern of temperature, rainfall is both seasonally and annually highly variable, with most rain accumulations occurring from November through April. **Table 2-2** summarizes the monthly temperature and precipitation statistics as measured in Laguna Beach (approximately 20 kilometers (12.4 miles) north of San Clemente) between 1928 and 2003.

Table 2-2 Monthly Climatic Summary at Laguna Beach, California (1928 to 2003)

Month	Ave. Max. Temperature in ^{O}F	Ave. Min. Temperature in ^{O}F	Ave. Total Precipitation m (in)
January	65.0	43.0	6.35 (2.50)
February	66.0	44.1	6.99 (2.75)
March	66.9	45.6	5.33 (2.10)
April	68.9	48.4	2.46 (0.97)
May	70.6	52.9	0.66 (0.26)
June	72.8	55.9	0.28 (0.11)
July	76.3	59.2	0.05 (0.02)
August	77.9	59.6	0.18 (0.07)
September	77.4	58.2	0.66 (0.26)
October	74.5	53.7	1.09 (0.43)
November	70.4	47.5	3.25 (1.28)
December	66.1	43.4	4.90 (1.93)

Source: Western Regional Climate Center (Station No. 044647)

Onshore winds across the south coastal region are from a westerly and southwesterly direction during the day while easterly and northeasterly breezes predominate at night. Wind speed tends to be somewhat greater during the dry summer months than during the rainy winter season. In January, light-to-moderate winds average 6 to 10 mph and blow from the northeast to the south-southwest more than three-quarters of the time. This flow is reversed during the day and the wind predominantly originates from the southwest at an average of 5 to 8 mph. Light winds averaging 3 to 6 mph originate from the east or southeast at night during July. This trend reverses during the day when winds predominate from the southwest, averaging 10 to 15 mph during the afternoon. In addition, extensive surface high-pressure systems over the Great Basin, combined with other meteorological conditions, can result in very strong, down slope “Santa Ana” winds during, especially, the winter and fall months. These winds may continue for a few days before “typical” circulation patterns recur.

2.5.2 El Nino Southern Oscillation Events (ENSO)

Southern Oscillation El Nino (ENSO) events are global-scale climatic variations with a duration lasting for approximately 2 to 7 years. They represent an oscillatory exchange of atmospheric mass as manifest by a decrease in sea surface pressure in the eastern tropical Pacific Ocean, a decrease in the easterly trade winds, and an increase in sea level on the west coast of North and South America (USACE-SPL, 1986). The interaction between the atmospheric and oceanic environment during these events drive climatic changes that can result in significant modifications of wave climate along the world’s coasts.

The severe winter seasons of 1982-1983 and 1997-1998, which produced some of the most severe storms to ever impact the Encinitas and Solana Beach coast, located approximately 56 km (35 miles) south of San Clemente, were the result of intense ENSO events. The atmospheric disturbance associated with these two events caused abnormally warm water temperatures, an actual reversal of the easterly trade winds, and increased the monthly mean sea levels by as much as 0.13 meters (0.42 feet) in the 1982-1983 season and 0.16 meters (0.52 feet) in the 1997-1998 season at La Jolla, San Diego (Flick, 1998).

An analysis of California tides, storm surges, and mean sea level during the El Nino winters of 1982-1983 and 1997-1998 was performed by Flick (1998). Comparisons of two gage stations at Los Angeles Harbor and La Jolla, show that the data are virtually interchangeable, after taking into account the respective tidal datum relationships. This assessment implies that the spatial difference of the ENSO effects between the two stations is insignificant. Since San Clemente is situated between the two locations, the ENSO effects observed at La Jolla or at Encinitas and Solana Beaches are applicable to the study area.

2.6 Coastal Processes

2.6.1 Water Levels, Tides and Sea Level Rise

Water levels within the surf zone consist of four primary factors within southern California: 1) astronomical tides, 2) storm surge and wave set-up, 3) short-term climatic variations related to ENSO events, and 4) global long-term rise in sea level.

Tides

Tides along the southern California coastline are of the mixed semi-diurnal type. Typically, a lunar day (approximately 25 hours) consists of two high and two low tides, each of different magnitudes. A lower low tide normally follows the higher high tide by approximately seven to eight hours while the time to return to the next higher high tide (through higher low and lower high water levels) is usually approximately 17 hours. Annual tidal peaks typically occur during the summer and winter seasons. The increased tidal elevations during the winter season can exacerbate the coastal impacts of winter storms.

Since tides in California have a spatial scale on the order of hundreds of kilometers, the prevailing tidal characteristics measured in La Jolla may be considered representative of the tidal elevations within the project area. The National Oceanic and Atmospheric Administration (NOAA) has established tidal datums for the La Jolla tidal station in San Diego County, approximately 81 kilometers (50 miles) southeast of the San Clemente Pier, based on 19 years of collected measurements from the 1960 through 1978 tidal epoch. The tidal characteristics at the La Jolla tidal station, referenced to the Mean Lower Low Water (MLLW) vertical datum are presented in **Table 2-3**. The highest recorded sea level at the La Jolla gage located at the terminus of the Scripps Pier was 2.38 meters (7.81 feet), MLLW measured on August 8, 1993.

In addition, it is worthy to note that the National Ocean Service (NOS) recently updated the La Jolla primary tide gage in order to re-compute the Mean Lower Low Water (MLLW) vertical datums for the 19-year tidal epoch extending from 1983 through 2001.

Table 2-3 Tidal Characteristics at Scripps Pier in La Jolla, California

Datum Plane	Elevation, meters (feet), MLLW
Highest observed water level (Aug. 8, 1993)	+2.38 (+7.81)
Mean Higher High Water (MHHW)	+1.64 (+5.39)
Mean High Water (MHW)	1.41 (+4.63)
Mean Tide Level (MTL)	0.85 (+2.78)
Mean Sea Level (MSL)	0.85 (+2.78)
National Geodetic Datum – 1929 (NGVD)	0.78 (+2.56)
Mean Low Water (MLW)	0.28 (+0.92)
Mean Lower Low Water (MLLW)	0.00 (0.00)
Lowest observed water level (Dec. 17, 1933)	-0.79 (-2.60)

Source: National Ocean Service (NOS), 2003

Storm Surge and Wave Setup

Storm surge is the super-elevation of the tidal level at the coast due to wind stresses and atmospheric pressure fluctuations acting upon the sea surface. Wind and atmospheric fluctuations associated with strong storms in southern California typically produce 0.3-0.6 meters (1-2 feet) storm surges (CCSTWS-SD, 1991). Due to a narrow continental shelf and the absence of tropical storms and/or hurricanes, storm surge heights on the California coast are small compared to those on the east and Gulf coasts where extreme surge heights of 1-3 meters (3-10 feet) are more typical and a peak 8 meters (25 feet) was documented during Hurricane Camille in 1969.

The winter storm of January 17 and 18, 1988 produced the all time record low barometric pressure for southern California. The still water level measured at the Los Angeles Harbor gage during this event was approximately 0.2 meters (0.7 feet) above the predicted astronomical tide elevation (National Ocean Service, 1988). West coast storm surges typically have time scales of 1-3 days, with longer surge episodes possible due to bunching of successive storm events.

Climatic Variation Related to ENSO Events

A positive departure in the annual mean sea level elevations occurs during strong El Nino episodes. As mentioned previously, these meteorological anomalies are characterized by low atmospheric pressures and persistent onshore winds. A review of recorded tide data indicates that six episodes (1914, 1930-1931, 1941, 1957-1959, 1982-1983, and 1997-1998) have occurred since 1905. Further analysis suggests that these events have an average return period of 14 years. During these past ENSO events, water levels have increased above the astronomical tides by about 6-centimeters (2.4-inches) with the effects lasting for 2 to 3 years (Flick, 1998).

An ENSO event also increases the probability that more severe winter storms will be experienced and the likelihood that storm waves could be coincident with times of higher water level. The highest recorded water level in the study area was measured on January 27, 1983. That episode included an estimated 0.24 meters (0.8 feet) of combined storm surge and seasonal sea level rise associated with the climatic variation of the El Nino event.

Sea Level Rise

Although the exact magnitude of the future sea level rise is unknown, the future level will depend on the extent of thermal expansion of the ocean water and the amount of melt water from receding continental glaciers and polar ice sheets. The proportion of rise associated with each of these contributions will depend largely upon the magnitude and pattern of global warming, resultant precipitation, glacial response and dynamics, time scale of oceanic mixing, and the stability of the west Antarctic ice sheet (U.S. Army Corps of Engineers, 1991). The U.S. Army Corps of Engineers considers potential relative sea level change in every feasibility study undertaken within the coastal zone. Corps of Engineers policy guidelines for sea level rise is defined in the Engineer Circular titled, "Water Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" dated July 1, 2009.

Historic regional sea level trends based on yearly mean sea level records are published by the National Ocean Service (NOS) (National Ocean Service, 2001). Monthly mean sea level variations are analyzed for 117 stations of the NOS National Water Level Observation Network having between 25 and 146 years of data. Monthly MSL data are used to obtain the average seasonal cycle, the residual time series, and the autoregressive coefficient of the residual with accurate estimates of standard errors. Historic trends in San Diego County, California indicate a positive sea level rise of +2.45 millimeters (0.1 inch) per year based on water level measurements during the period 1950 to 1999. If past trends were to be projected into the future in San Diego County, a sea level rise of 0.10 m/yr (0.32 ft/yr) would be expected over the next 50 years.

The long-term consequences of global warming and sea level rise may be the occurrence of more severe ENSO events, more frequent coastal storms, and increased incidents of shoreline erosion and coastal flooding. In addition, an increased sea level will encroach further landward on milder sloping beaches causing an “apparent” shoreline recession.

Relative sea level rise is considered to have direct impacts on the 50-year future without-project and future with-project conditions. Relative sea level rise can be significant for long-term beach erosion rates. As the relative water level rises, a landward migration of the shoreline can be expected assuming the profile shape does not change and the longshore sediment transport is in equilibrium (i.e., no erosion or deposition).

2.6.2 Waves

Wave climatology information is available for the offshore area of San Clemente in the form of direct measurements as part of the Coastal Data Information Program (CDIP). The CDIP shallow-water gage (Station ID 052) most applicable to San Clemente is located approximately 300 m (985 ft) offshore of the San Clemente Pier in 10.2 meters (33 ft) of water. The gage is a directional wave height recorder with a 178-month record during the period 1983 to 1998 that includes wave height, period and direction. Buoy data consist of a total of four observations per day or every six hours. The height and direction data records are intermittent in that reporting of the data was only available for approximately 141 of the 178 months with one long gap occurring during the period of July 1988 to July 1991, which accounted for the majority of the missing records.

Wave Heights

The annual maximum wave heights for each year are presented in **Table 2-4**. As is evident from the illustration, the most commonly occurring significant wave height is in the range of 0.80 to 1.00 meter (2.7-3.3 ft) with no measured significant wave heights exceeding 4.0 meters (13.1 ft), as the maximum significant wave height was 3.63 meters (12 ft) measured January 18, 1988.

Since it is widely recognized that the most severe wave climate occurs during the winter season, it was important to develop the wave climatology based strictly on the winter wave population defined as December through March.

Table 2-4 Annual Maximum Wave Heights, 1983 – 1998

Year	Month/ Day	Significant Wave Height, (H_s), m (ft)
1983	December 10	3.10 (10.2)
1984	April 1	1.85 (6.1)
1985	November 29	2.18 (7.2)
1986	February 16	3.56 (11.7)
1987	March 16	2.24 (7.4)
1988	January 18	3.63 (11.9)
1991	November 15	2.06 (6.8)
1992	January 30	2.32 (7.6)
1993	February 18	2.66 (8.7)
1994	February 7	2.00 (6.6)
1995	January 5	3.22 (10.6)
1996	October 26	2.24 (7.4)
1997	December 6	2.31 (7.6)
1998	January 30	2.99 (9.8)

Wave Periods

The dominant wave periods are in the range between 12 and 14 seconds, with a smaller secondary peak between 6 and 8 seconds. The two peaks in the distribution demonstrate the dual sea/ swell nature of the wave climate. Shorter period waves are typically associated with local sea conditions; while longer period waves are associated with offshore swell conditions traveling over greater distances.

Wave Directions

Approximately 91 percent of the waves propagating into the nearshore zone from approximately 300 meters (984 ft) offshore of the San Clemente Pier approach from the relatively narrow 20-degree band between the 220^o and 240^o azimuths, and all other approach directions are minor or negligible. There is a small fraction of waves (0.7 percent) approaching from between 160^o and 220^o, which are directions considered to be from tropical depressions or southern hemisphere origins. There is a predominate westerly wave direction that envelops both local seas and extratropical swells. It is important to note that shoreline normal within the San Clemente project study area is approximately 235^o and that shoaling and refraction effects are included in the wave buoy data at the point of observation, approximately 10 meters (33 ft) of water depth.

2.6.3 Currents

The offshore currents, including the California Current, the California Undercurrent, the Davidson Current, and the Southern California Countercurrent (also known as the Southern California Eddy), consist of major large-scale coastal currents, constituting the mean seasonal oceanic circulation with induced tidal and event specific fluctuations on a temporal scale of 3 to 10 days (Hickey, 1979).

The California Current

The California Current is the equatorward flow of water off the coast and is characterized as a wide, sluggish body of water that has relatively low levels of temperature and salinity. Peak currents with a mean speed of approximately 12.5 to 25 centimeters (5-10 inches) per second occur in summer following several months of persistent northwesterly winds (Schwartzlose and Reid, 1972).

The California Undercurrent

The California Undercurrent is a subsurface northward flow that occurs below the main pycnocline and seaward of the continental shelf. The mean speeds are low, on the order of 5 to 10 centimeters (2-4 inches) per second (Schwartzlose and Reid, 1972).

The Davidson Current

The Davidson Current is a northward flowing nearshore current that is associated with winter wind patterns north of Point Conception. The current, which has average velocities between 15 and 30 centimeters (6-12 inches) per second, is typically found off the California coast from mid-November to mid-February, when southerly winds occur along the coast (Schwartzlose and Reid, 1972).

The Southern California Countercurrent

The Southern California Countercurrent is the inshore part of a large semi-permanent eddy rotating cyclonically in the Southern California Bight south of Point Conception. Maximum velocities during the winter months have been observed to be as high as 35 to 40 centimeters (14-16 inches) per second (Maloney and Chan, 1974).

Alongshore currents are those nearshore currents that travel parallel to the shoreline extending throughout, and slightly seaward of, the surf zone. The alongshore currents in the coastal zone are driven primarily by waves impinging on the shoreline at oblique angles. The rate of alongshore sediment transport varies in proportion to the characteristics of the regional wave climate and the directional predominance. The surf zone alongshore currents within the project area can attain maximum velocities of approximately 1 meter (3.3 ft) per second. Typically, summer swell conditions produce northerly drifting currents, while large winter storm events from the west and northwest produce southerly alongshore currents. Overall within the project study area, the general magnitude and persistence of the northerly winter storms generally results in a net southerly littoral drift; however, reversals are common during the summer months.

Cross-shore currents exist throughout the study area, particularly at times of increased wave activity. These currents tend to concentrate at creek mouths and shore perpendicular structures, but can occur anywhere along the shoreline in the form of rip currents and return flows of complex circulation. To date, no information is available that quantifies the velocities of these currents within the project area; however, studies have shown that the velocity of rip currents, in general, can exceed 2 meters (6.6 ft) per second (Dean and Dalrymple, 1999).

2.7 Littoral Processes

The San Clemente project study area resides within the Oceanside Littoral Cell, which extends for approximately 86 kilometers (53 miles) from Dana Point in Orange County to Point La Jolla in San Diego County. The shoreline within this littoral cell displays a wide variety of coastal features including cliffs, headlands, beaches composed of sand and/ or cobbles, rivers, creeks, tidal lagoons and marshes, submarine canyons, man-made shore and bluff protection devices of various kinds, and major harbor structures. The cell is divided into three sub-cells based on natural physiographic units: (1) Dana Point to San Mateo Point, (2) San Mateo Point to Carlsbad Submarine Canyon, and (3) Carlsbad Submarine Canyon to Point La Jolla. The City of San Clemente is located in the northernmost sub-cell (Dana Point to San Mateo Point).

2.7.1 Sediment Sources

Numerous rivers and small streams discharge sediment into the Oceanside Littoral Cell. San Juan Creek and San Mateo Creek are considered major river systems for the influx of sediment into the north sub-cell. Extracts from a listing compiled from the results of various studies (CCSTWS) are presented in **Table 2-5** and provides a range of estimates of the sediment loads carried by fluvial systems of this littoral sub-cell. This table illustrates the relatively small amount of sediment input from San Juan Creek.

San Juan Creek is 7.4 km (4.6 mi) northwest on the updrift[1] side of San Clemente Pier. Dana Point is the southern updrift boundary headland for the Oceanside littoral cell where it is presumed no appreciable sediment is entering the cell. Therefore, San Juan Creek represents the only major source of sediment input to the immediate project area. San Mateo Creek, although physically closer, is in the downdrift direction and is not believed to be a major contributor of sediments to the project area.

The San Juan Creek discharge averages 20,383 m^3/yr (26,702 yd^3/yr). This quantity is small given the fact that some of the discharged river material is likely lost offshore as fines and some is lost/trapped updrift prior to reaching the San Clemente project area.

It is noted that river flows and the resultant sediment delivery to beaches is episodic due to the semi-arid nature of the climate and watersheds/rivers deliver sediment only during rainy/wet years. Thus, sediment to beaches tends to be delivered in large "pulses", where a large quantity is delivered to the beach in one year followed by several years of low or no sediment delivery.

Table 2-5 Sediment Discharge from Rivers and Streams

Previous Studies	River / Stream Discharge Rate m^3/yr (yd^3/yr)		
	San Juan	San Clemente	San Mateo
Drainage Area (hect / mi^2)	45,455 (175.5)	5,154 (19.9)	34,188 (132)
Moffatt&Nichol 1977	12,980 (17,000)	10,946 (14,340)	1,702 (2,240)
CCSTWS 84-4 (1984)			24,427 (32,000)
Simons/Li 1985	6,107 (8,000)		12,213 (16,000)
CCSTWS 88-3 (Simons/Li 1988)	15,603 (20,440)	786 (1,030)	3,729 (4,885)
CCSTWS 90-2 (Moffatt&Nichol 1990)	27,480 (36,000)		6,412 (8,400)
USACE-SPL 1999	36,749 (52,071)		

[1] Directional convention for this study is: "updrift" and "upcoast" refers to northerly and/or westerly direction; and "downdrift" and "downcoast" refers to the southerly and/or easterly direction.

2.7.2 Long Term Shoreline Change

Shoreline change has been calculated based on the “dry” beach width which is defined as that portion of the beach between the foreshore berm contour and the backshore. The shoreline change rate has been applied uniformly to all reaches. The design shoreline change rate in quantitative detail is discussed in Appendix D of the EIS/EIR.

Historical Shoreline Change

Shoreline changes within the Oceanside Littoral Cell were investigated during the CCSTWS-SD (1991) using historical maps, nautical charts, aerial photos, and the results of ground and bathymetric survey efforts. The results of these extensive efforts are shown in **Table 2-6**.

Table 2-6 Long Term Shoreline Change Rates in San Clemente Area

	MHHW Shoreline Change Rate m/yr (ft/yr)			Max Seasonal MHHW Movement m (ft)	
Location	1940-1960	1960-1980	1980-1989	Summer	Winter
SC 1623	-0.06 (-0.20)	-0.21 (-0.70)	2.16 (7.10)	7.7 (25.4)	-7.9 (-26)
SC 1660	0.00 (0.00)	0.18 (0.60)	-0.61 (-2.00)	5.2 (17)	-10.4 (-34)
SC 1680	0.76 (2.50)	-0.12 (-0.40)	0.43 (1.40)	13.9 (45.5)	-17.5 (-57.4)
SC 1720	0.00 (0.00)	0.00 (0.00)	1.46 (4.80)	9.2 (30)	-8.2 (-27)
DB 1805	-0.58 (-1.90)	2.47 (8.10)	-3.75 (-12.30)	7.6 (25)	-13.9 (-45.6)
DB 1850	-0.18 (-0.60)	2.84 (9.30)		0.8 (2.7)	-21.4 (-70.2)
DB 1895	0.76 (2.50)	-0.12 (-0.40)	-0.15 (-0.50)	7.5 (24.6)	-9.6 (-31.4)
DB 1900	0.00 (0.00)	-0.58 (-1.90)	-3.05 (-10.00)	18.2 (59.8)	-27.9 (-91.4)

This table exemplifies the alongshore variation of the shoreline change within the immediate vicinity of the San Clemente study area, which extends between SC 1623 (State Beach) and SC 1720 (Shorecliffs). There are contradictory trends observed in the data as the data sets are out of phase with adjacent locations; meaning that a transect which is erosional and/or accretional is adjacent to a transect which is accretional and/or erosional over the same time period.

The mean values during the 1940-1960 and 1960-1980 periods are similar in magnitude; however, the mean values during the 1980-1989 period are remarkably higher. Detailed inspection of the data indicates a shoreline that continuously fluctuates between erosional, balanced, or accretional. During the period 1940-1960, the shoreline indicated essentially zero change with a +0.76 m/yr (2.5 ft/yr) change in the vicinity of SC 1680. During the period 1960-1980, the shoreline vacillated in the alongshore direction between positive and negative. The shoreline change was approximately equal between positive and negative ranging from -0.21 m/yr (-0.69 ft/yr) and +0.18 m/yr (0.60 ft/yr). During the period 1980-1989, the shoreline was predominantly positive with accretion rates ranging from +0.43 m/yr (1.4 ft/yr) to +2.16 m/yr (7.1 ft/yr); an erosion value of -0.61 m/yr (-2.0 ft/yr) was recorded at SC 1660.

Beach Width Monitoring

The City of San Clemente initiated a beach monitoring program as part of the non-Federal in-kind contributions for this study (Coastal Frontiers, 2002). The general objective of the monitoring program was to document changes in the condition of the shoreline between Dana Point Harbor and San Mateo Point; thereby, providing a basis for evaluating the impacts of natural events and anthropogenic operations. The program includes semi-annual full cross-shore profile surveys at 11 representative sites and bi-monthly beach width measurements at 9 of the 11 profile sites. The full cross-shore profiles were obtained by contract whereas the City of San Clemente lifeguards obtained the bi-monthly beach width measurements.

A description of the transect locations is given in **Table 2-7**. The 11 profile locations include 6 historical locations originally established by the CCSTWS-SD (1991), and 5 locations established specifically for the beach monitoring program in support of this study.

Table 2-7 San Clemente Area Beach Profile Transects

Site #	Transect Designation	Location	Origin
1	DB-1850	N. Doheny State Beach	CCSTWS
2	DB-1805	N. Doheny State Beach	CCSTWS
3	SC-1720	Shorecliffs	CCSTWS
4	SC-1705	Capistrano Trailer Court	Est. Oct. 2001
5	SC-1700	North Beach	Est. Oct. 2001
6	SC-1695	Dije Court	Est. Oct. 2001
7	SC-1680	Linda Lane	CCSTWS
8	SC-1660	T-Street	CCSTWS
9	SC-1645	Lost Winds	Est. Oct. 2001
10	SC1623	San Clemente State Beach	CCSTWS
11	SC-1605	Cottons Point	Est. Oct. 2001

Recent Shoreline Change Rate

The shoreline change rate can be determined from the aggregate of measured data collected in support of the CCSTWS-SD (1991) and the City of San Clemente's sponsored beach width monitoring program. This data set is comprised of a compilation of measurements obtained from the 1980's to the present day.

It is noted that this beach width data set is expressed relative to the Mean Sea Level (MSL) contour as opposed to the berm definition that has been adopted for this study. The beach widths are the distance between a fixed point on the backshore and the approximate location of the MSL contour, which is a commonly accepted definition for this level of analysis. The MSL beach width incorporates a portion of the "wet" beach (e.g. the foreshore between the MSL contour and the berm), whereas the berm beach width definition incorporates only the "dry" portion of the beach. Thus the MSL beach widths will be inherently greater than the berm beach widths. Based on a typical beach slope within the study area of 8H:1V, a berm elevation of +6.2 m (20.3 ft), and a MSL contour elevation of +1.64 m (5.4 ft), the estimated horizontal beach width attributable to this contour elevation difference is approximately 35 meters (114 feet). As a result, the MSL indicates a positive beach width where the beach has been previously defined in many reaches as having zero width (see Section 2.1).

Based on the assumption that the accretion/erosion trend for the berm width would coincide with the trend for the MSL line, the linear regression for each data set representing the trend of the dry berm is developed. The slope of the lines represents the mean shoreline trend for each respective data set. The summary of the recent long-term shoreline change rates is presented in **Table 2-8**. The shoreline change data are considered together to obtain representative values for the entire study area. The mean shoreline change rate is –0.20 m/yr (-0.7 ft/yr), the maximum erosion rate is –0.61 m/yr (-2.0 ft/yr) and the maximum accretion rate is +0.38 m/yr (+1.24 ft/yr).

Table 2-8 Summary of Recent Long Term Shoreline Change Rates

Location	Erosion Rate, m/yr (ft/yr)
SC 1720, Shorecliffs	+0.38 (+1.24)
SC 1680, Linda Lane	-0.24 (-0.79)
SC 1660, T – Street	-0.61 (-2.00)
SC 1623, State Beach	-0.33 (-1.09)

There are contradictory trends observed in the data as the Shorecliffs data set is out of phase with the other three. The three data sets around the Pier are consistent in trend and phase. The data sets indicate consistent erosion and accretion trends at the same time; however, the mean values are similar in magnitude. The data set at Shorecliffs is nearly opposite in behavior. The beach is erosional and/or accretional when the others are accretional and/or erosional.

2.7.3 Short-Term Storm Induced Beach Change

Short-term shoreline erosion data have been collected within the U.S. Army Corps of Engineers, Los Angeles District as part of the Orange County Beach Erosion Control Project (Surfside-Sunset). This data set represents a collection of linear beach widths collected at 26 locations over a period of 33 years and is used in the present analysis to estimate shoreline response under storm conditions for the San Clemente project study area.

The data set collected at 26 locations represents various beach and shoreline conditions. The measured shoreline response data was correlated to ten known significant storms to estimate the degree of short-term storm-induced erosion under various intensities of storm events. However, the aforementioned study area is morphologically very different from the San Clemente study area. The northern Orange County area primarily consists of wide sandy beaches and a full sand profile. This is compared to the San Clemente study area that has been shown to be primarily a hard bottom area with a thin lens of sand along the shoreline. Thus the San Clemente area has inherently less beach width to exchange in the cross-shore direction due to storm induced impacts. Therefore, the raw data collected from northern Orange County was modified to more realistically reflect the expected San Clemente shoreline response.

2.7.4 Cross-Shore Profiles

Cross-shore profiles are compiled from the LIDAR topographic data and bathymetric measured data for all reaches and are shown in Appendix D of the EIS/EIR. Profiles from Reach 6 in the vicinity of the San Clemente Pier and Reach 7 in the vicinity of Mariposa Point may be considered to be representative of a non-armored and armored shoreline, respectively, throughout the study area. Only the portion of the profile from the bluff to the waterline is shown in order to better illustrate the detail of the foreshore and backshore regions. The profile centerline is established at the seaward rail of the SCRRA railroad. The Pier area beach profile indicates a typical berm elevation of +5.2 meters (+17 feet), a typical foreshore slope of 8H:1V to 10H:1V, an offshore slope of 110H:1V, and a railroad elevation at approximately +6.4 meters (+21 feet), MLLW. The Mariposa Point area profile indicates a mean revetment crest elevation at +6.9 meters (+23 feet), MLLW, typical revetment slope of 1H:1V, toe elevation at approximately 0.0 meters, MLLW, an offshore slope of 110H:1V, and a railroad elevation at approximately +6.4 meters (+21 feet), MLLW.

2.7.5 Foreshore Slopes

Foreshore slope data was obtained by the City of San Clemente lifeguards, who obtained direct measurements of the foreshore slope as part of the aforementioned beach width monitoring program. Approximately 21 measurements were obtained 2 to 3 times each month for 12 month duration during the period of November 2001 to November 2002 at nine selected locations throughout the study area. The slope was measured in degrees from horizontal and converted to the slope cotangent. Assuming that the year of data collection adequately represents the future annual project period, this data set may be considered to represent the typical annual variation of foreshore slope values across the study area.

2.7.6 Profile Sediment Thickness

Data collected for the Sand Thickness Survey Report (USACE-SPL, 1988) allows estimation of the available sediment supply and consequently any potential limits to erosion. The work performed in this study consisted of jet probing activities along various profiles to determine the available sediment thickness. Three profiles in the San Clemente area were jet probed including SC-1623 (San Clemente State Beach), SC-1660 (T-Street) and SC-1720 (Capistrano Shores). The survey results indicate that the sediment thickness is relatively thin throughout the project nearshore area in depths from – 3 to –9 meters (-10 to -30 ft), MLLW and; conversely, that the associated hard bedrock substrate is relatively high relative to the shoreline position. The results of this analysis are presented in **Table 2-9**.

In addition, the measurement results identified cobbles, boulders, and other hard substrate at various depths along the profile. The observations include “some pebbles scattered on beach surface and some boulders visible at backshore” and “offshore sand-stone outcrops with local bottom relief of 1 ft”. This information is consistent with 2002 geologic information collected during geophysical studies conducted as part of this study, and reported in Appendix E of the EIS/EIR. However, as the data was collected over 20 years ago, it is presented as evidence of past conditions and should not be considered indicative of current conditions.

Table 2-9 Summary of Profile Sediment Thickness

Range Line	No.	Range	Elevation (MLLW)	Sand Thickness	Bedrock Elevation (m, MLLW)
SC-1623	1	21.1 m (69.3 ft)	4.1 m (13.5 ft)	3.1 m (10.1ft)	+1.0 (3.3 ft)
SC-1623	2	34.6 m (113.5 ft)	3.4 m (11.1 ft)	3.2 m (10.5ft)	+0.2 (0.7 ft)
SC-1623	3	51.7 m (169.6 ft)	2.1 m (6.9 ft)	2.4 m (7.7 ft)	-0.3 (-1.0 ft)
SC-1623	4	194.2 m (636.8 ft)	-3.5 m (-11.4 ft)	0.1 m (0.4 ft)	-3.6 (-11.8 ft)
SC-1623	5	266.1 m (872.8 ft)	-6.0 m (-19.6 ft)	0.3 m (0.9 ft)	-6.3 (-20.7 ft)
SC-1623	6	504.2 m (1653.8 ft)	-9.3 m (-30.5 ft)	0.6 m (1.8 ft)	-9.9 (-32.5 ft)
SC-1660	1	11.5 m (37.6 ft)	5.0 m (16.3 ft)	4.5 m (14.8ft)	+0.5 (1.6 ft)
SC-1660	2	23.5 m (77.2 ft)	3.1 m (10.2 ft)	3.4 m (11.2ft)	-0.3 (-1.0 ft)
SC-1660	3	42.9 m (140.6 ft)	1.5 m (4.8 ft)	2.1 m (6.9 ft)	-0.6 (-2.0 ft)
SC-1660	4	232.8 m (763.5 ft)	-3.1 m (-10.1 ft)	0.1 m (0.4 ft)	-3.2 (-10.5 ft)
SC-1660	5	462.4 m (1516.5 ft)	-6.5 m (-21.3 ft)	0.7 m (2.2 ft)	-7.2 (-23.6 ft)
SC-1660	6	673.6 m (2209.5 ft)	-9.0 m (-29.6 ft)	2.7 m (8.8 ft)	-11.7 (-38.4 ft)
SC-1720	1	10.9 m (35.9 ft)	4.7 m (15.4 ft)	4.5 m (14.9ft)	+0.2 (0.7 ft)
SC-1720	2	24.8 m (81.4 ft)	2.7 m (8.7 ft)	2.9 m (9.6 ft)	-0.2 (-0.7 ft)
SC-1720	3	46.5 m (152.6 ft)	0.6 m (1.9 ft)	1.0 m (3.3 ft)	-0.4 (-1.3 ft)
SC-1720	4	165.2 m (541.9 ft)	-2.5 m (-8.1 ft)	0.0 m (0.0 ft)	-2.5 (-8.2 ft)
SC-1720	5	494.8 m (1622.9 ft)	-6.7 m (-21.9 ft)	0.2 m (0.5 ft)	-6.9 (-22.6 ft)
SC-1720	6	879.5 m (2884.9 ft)	-8.6 m (-28.3 ft)	0.2 m (0.7 ft)	-8.8 (-28.9 ft)

2.7.7 Sediment Budget

A sediment budget for without-project conditions has been developed based on the CCSTWS-SD (1991). Development of the sediment budget involves defining the sediment sources, sinks, losses; transport modes; erosion and accretion rates; and balancing the resultant budget. Some additional information was obtained during this study to enhance the previously developed sediment estimates. Compilation of the sediment budget specific to San Clemente is described hereinafter and is further described in the CCSTWS-SD (USACE-SPL, 1991).

The analysis of the budget of sediment for this cell has been carried out for three time periods: (1) the period from 1900 – 1938, (2) a mild, uniform weather period from 1960 – 1978, and (3) a period of more variable wave climate covered by the CCSTWS-SD studies from 1983 – 1990. The 1900 – 1938 "natural" budget permits an uncluttered look at the cell as it predates construction of dams and Oceanside Harbor, although it necessarily draws on some findings from later studies. The mild, uniform period from 1960-1978 was selected to evaluate the effects of Oceanside Harbor at a time when the wave climate was consistent from year to year and less variable than the present wave climate. The last period of more variable wave climate extending from 1983 – 1990 emphasizes the change in wave climate from one that gave a consistent, strong southerly littoral transport to one that yields a more variable transport with a net northerly component in some years. The resultant sediment budget for the three time periods is shown in **Table 2-10**.

Table 2-10 Sediment Budget for Dana Point Subcell (Dana Point to San Mateo Point)

	1900-1938		1960-1978		1983-1990	
	Input (m^3/yr)	Output (m^3/yr)	Input (m^3/yr)	Output (m^3/yr)	Input (m^3/yr)	Output (m^3/yr)
Q_l	0	130,000	0	130,000	0	35,000
Q_n	0	15,000	0	15,000	0	5,000
$Q_{b,o}$	130,000	45,000	90,000	45,000	45,000	0
Q_a	0	0	90,000	0	0	0
$Q_{r,s}$	65,000	0	45,000	0	0	0
Total	**+195,000**	**-190,000**	**+225,000**	**-190,000**	**+45,000**	**-40,000**
Net Sand Vol Change (m^3/yr)	+5,000		+35,000		+5,000	
Shoreline Change (m/yr)	+0.03		+0.18		+0.03	

Source: USACE-SPL, 1991
Notes:
Q = total sand transport rate into or out of cell
a = artificial nourishment, bypassing, dredging, etc
b = blufflands erosion; includes seacliffs, gullies, coastal terrace, slumps, etc as distinct from rivers
l = longshore transport of sand in and near the surfzone
n = nearshore transport along the coast, outside the surfzone
o = onshore/offshore transport at the base of the shorerise
r = river yield to the coast
s = lost to submarine canyons

The resultant sediment budget indicates the shoreline is essentially in balance between erosion and accretion. The budget is considered to be in balance when the shoreline change rate, computed from the volume flux is less than 0.03 m/yr (0.1 ft/yr). The shoreline indicates a balance in the "natural" time period and the most recent variable wave climate time period. The net volume flux indicates the budget is very slightly accretional during the uniform wave climate period.

2.7.8 Summary

The shoreline morphology of the San Clemente area can be summarized as a lack of sediment supply is creating a chronic, mild, long-term erosional condition. As the beach continues to erode over time, chronic, mild, long-term erosion is expected to exacerbate existing storm wave related structure damages and create future additional damages to the railroad.

The sediment budget as described is applicable to the northern sub-cell of the Oceanside Littoral Cell. The northern littoral sub-cell is approximately 13 km (8 mi) long from Dana Point to San Mateo Point. Located within this sub-cell is the project area which is approximately 1,040 m (3,400 ft) long. The geologic conditions within the littoral sub-cell indicate that the entire area is exposed bedrock throughout the regime. Mapping indicates the offshore area is primarily hard bottom covered in some places by shallow pockets or a thin veneer of sediment. Raised rock reefs are common. The beach is a relatively narrow ribbon of sand trapped against the coastal bluffs; the small amount of sediment within the littoral system is worked by waves to the upper limit of the profile.

The sediment budget, developed by the CCSTWS, is applicable over the 13 km (8 mi) reach. Due to the lack of available data, the sediment budget, as developed, does not allow detailed volumetric budget estimates on a smaller spatial scale. Specifically, the lack of spatially refined data does not allow a detailed volumetric analysis of the project area. The sediment budget for the sub-cell has been determined to be +5,000 cubic meters per year, with a corresponding +0.03 m/yr shoreline change rate. The positive sign (+) suggests that the shoreline is accretional. However, this volume flux rate is very small and is within the error associated with the analysis. Thus, this sediment budget (and shoreline change rate) could have easily been positive or negative. The budget is considered to be in balance when the shoreline change rate, computed from the volume flux, is less than 0.03 m/yr (0.1 ft/yr). It is further noted that 5,000 cubic meters spread over 13 km (8 mi) of shoreline is virtually undetectable.

The littoral sub-cell is dominated by sediment inputs from San Juan Creek at the northern boundary. San Juan Creek presents the single largest source of sediment within the entire sub-cell. Thus, the greatest change rates, both for sediment budget and shoreline change, will be measured in the immediate vicinity of the creek mouth. It is entirely probable, and likely, that other areas of the sub-cell farther removed from San Juan Creek will exhibit a sediment volume flux both negative (erosion) and positive (accretion). In other words, other areas of the littoral sub-cell can be either erosional or accretional, yet their signal will be masked by what is occurring in the vicinity of San Juan Creek.

The measured shoreline change rate at the project area in San Clemente has been determined to be –0.10 m/yr (-0.33 ft/yr). This value represents a shoreline that is marginally erosive, at best. This shoreline change rate is determined by an aggregation of historic and recent profile survey data. The data, when viewed in aggregate, indicates that since the 1980's the shoreline has been in a mildly erosive condition. The marginally erosive shoreline change rate is consistent with all of the prevailing geophysical information. It is believed that over decadal time scales, the shoreline has changed from a largely static condition to a mildly erosive condition due to anthropogenic influences and sediment trapping in the watershed due to urban development.

2.8 Environmental Resources

2.8.1 Biological Resources

The predominant intertidal habitat along San Clemente's shoreline is sandy beach, although some rocky outcrops that extend from mid-beach to the low intertidal are present at Mariposa Point (Reach 7), north of San Clemente Pier, as shown in **Figure 2-14**. Beyond the surf zone, the seafloor is a mosaic of sand and low-to-high relief patch reef. Some pinnacles of the reef are visible in the nearshore zone at low tide while two prominent offshore pinnacles break the surface offshore of Mariposa Point and south of the San Clemente Pier. Other reef habitats are located south of the Pier offshore of T-Street that extend west, and then north around the end of the San Clemente Pier, and secondly, offshore San Mateo Point (Reach 1). Sensitive biological resources are found within a broad band of the region between San Clemente and Oceanside that have a potential to be affected by beach stabilization and/ or protection projects. However, there are a few species that may use the nearshore zone for foraging, namely, the California least tern (*Sterna antillarum browni*) and the California brown pelican (*Pelecanus occidentalis occidentalis*)

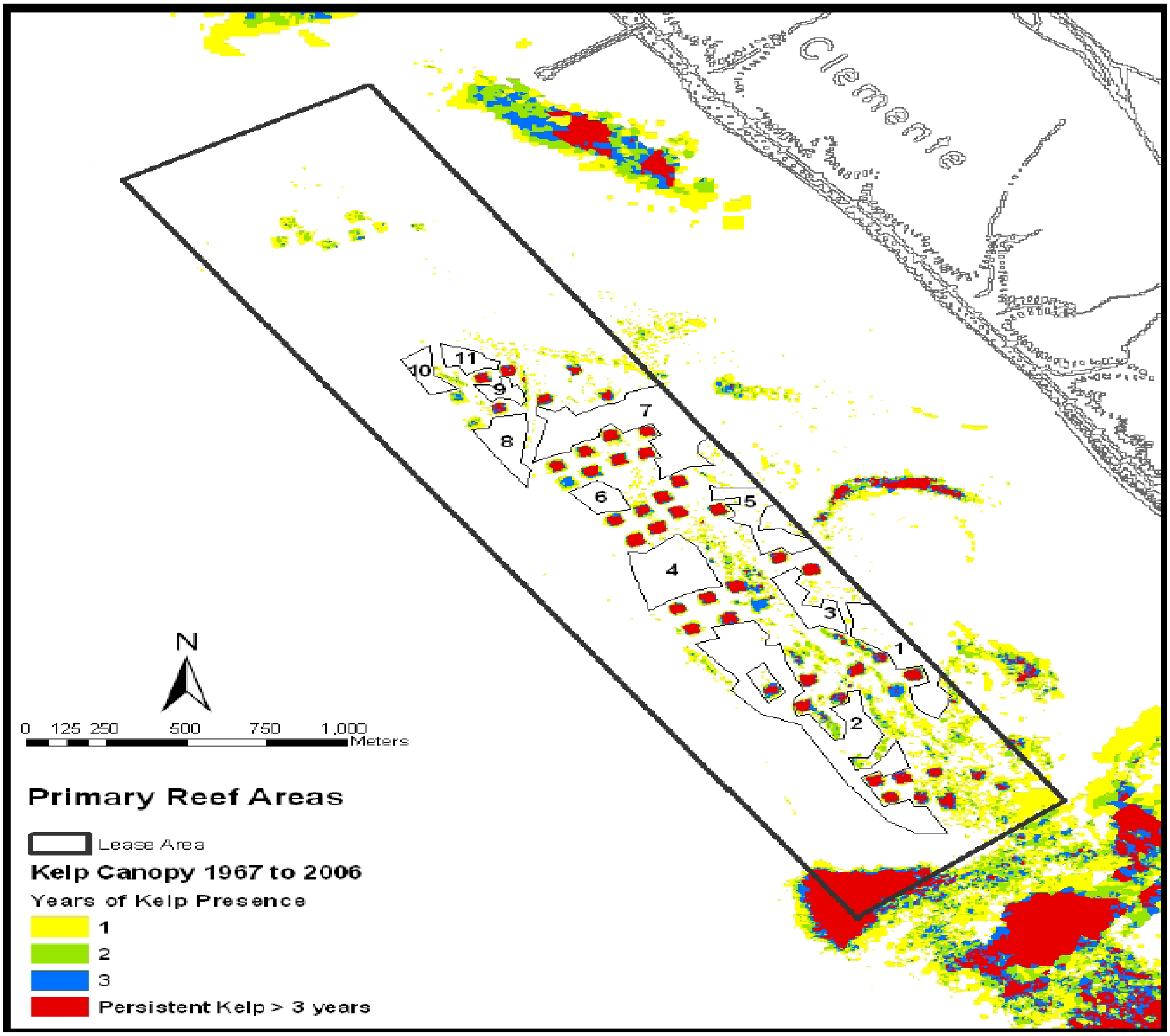


Figure 2-14 Marine Shoreline and Offshore Habitats

2.8.2 Marine Habitats

Three types of vegetated habitats, nearshore kelp and macroalgae, surfgrass beds, and offshore kelp beds, are present in the intertidal to subtidal habitats off San Clemente. Although the predominant intertidal habitat along San Clemente's shoreline is sandy beach, an area of rocky intertidal is present at Mariposa Point (Reach 7) approximately 975 meters (3,200 feet) north of the San Clemente Pier. Boulders and rocky outcroppings in this area support a variety of algal species. In the high intertidal, boulders support filamentous green algae (*Enteromorpha* spp.). The mid to low intertidal algae composition is dominated by encrusting red algae (*Lithophyllum* spp., *Lithothamnion* spp.), encrusting brown algae (*Pseudolithoderma* spp.), and coralline algae (*Corallina* spp.). Filamentous red algae, consisting of several species, and green algae (*Enteromorpha* spp. and *Ulva* spp.) also occur in these zones. Larger brown algae species colonize the base of the intertidal reef throughout the area, including palm kelp (*Eisenia aborea*) and feather boa kelp (*Egregia menziesii*). Surfgrass (*Phyllospadix* spp.) is present in the low intertidal beginning approximately 91 meters (300 feet) offshore of the sandy beach. Surfgrass is present throughout the low intertidal platform of Mariposa Point. Other offshore rocks are found approximately 1,950 meters (6,400 feet) (Reach 4) south of the San Clemente Pier.

The shallow subtidal zone for much of the project area is a mixture of sand and boulder, with occasional outcrops of exposed shale bedrock. The subtidal areas between North Beach and Mariposa Point and offshore of Linda Lane, Mariposa Point, and T Street support filamentous red algae, coralline algae, crustose coralline algae, feather boa kelp, palm kelp, and surfgrass. Historically, offshore kelp beds, dominated by giant kelp with an understory of feather boa kelp and palm kelp, have been prevalent along this section of coastline, but within the last several years, the canopy has experienced a sharp decline (Coastal Resources Management, 2000). During surveys in June 2000, Coastal Resources Management (CRM) found low density kelp beds with little or no surface canopy approximately 610 meters (2,000 feet) off of Mariposa Point and 1,219 meters (4,000 feet) from North Beach at depths between –7 and –8.5 meters (-23 and –28 feet) MLLW. Another bed was observed 198 meters (650 feet) off of San Clemente Pier (T Street) at a depth of 4.9 meters (16 feet) in October 1999. This patch was not observed during the June 2000 survey (CRM, 2000). Much of the kelp observed in June 2000 was ragged and covered with fouling ectoprocts (*Bryozoa*); however, newly settled recruit plants were also present (CRM, 2000). In the proposed project area (Reach 6) the impact to the resources has been minimized with the footprint of the project. As monitoring occurs after construction phase any further adjustments to placement of sand can be evaluated.

Soft Bottom Communities

Common benthic invertebrates observed on southern California sandy beaches between the low and high tide marks include sand crabs (*Emerita analoga*), beach hoppers (*Orchestoidea* spp.), burrowing polychaete worms, amphipods, isopods, and clams.

The offshore benthos in the shallow subtidal are expected to be similar to species that are common to north San Diego County located approximately 40 kilometers (25 miles) from the project area. Subtidal invertebrates commonly observed in San Diego County that are likely to be found in the project area include tube-dwelling polychaete worms (e.g. *Diopatra* spp., *Loimia medusa*, *Pista pacifica*), sand dollar (*Dendraster excentricus*), crabs (*Heterocrypta occidentalis*, *Portunis xantusii*, *Randallia ornata*), hermit crabs (*Pagurus* spp., *Pagurites* spp.), marine snails (*Nassarius fossatus*, *Olivella biplicata*, *Polinices* spp.), clams (*Ensis* spp.), armored sea star (*Astropecten armatus*), tube anemones (*Harenactis attenuata*, *Zaolutus actius*), sea pens (*Stylatula elongata*), and sea pansies (*Renilla kollikeri*) (MEC, 2002; Thompson et al, 1993).

The number of species and density of bottom dwelling macroinvertebrates is expected to be low in the area of potential offshore borrow sites, which will most likely be within the inner shelf zone. Infaunal abundance and diversity is generally low in the inner shelf compared to the middle and outer shelf because the inner shelf zone is regularly disrupted by wave activity and oceanic swell (SANDAG, 2000). Polychaete worms and/ or small, mobile crustaceans typically dominate the inner to middle shelf infaunal communities of the SCB (SANDAG, 2000).
Fish species that occur within the study area are expected to be similar to those found in San Diego County. Fish commonly found over sandy subtidal habitat (less than 9 meters or 30 feet) off of San Diego County beaches include California halibut (*Paralichthys californicus*), speckled

sanddabs (*Citharichthys stigmaeus*), barred surfperch (*Amphistichus argenteus*), white croaker (*Genyonemus lineatus*), bat ray (*Myliobatus californica*), and shovelnose guitarfish (*Rhinobatos productus*) (MEC 2002, SANDAG 2000). Northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), Pacific bonito (*Sarda chiliensis*), and topsmelt (*Athernops affinis*) are commonly encountered in the water column just beyond the surfzone (MEC, 2002; SANDAG, 2000). Flatfish, including speckled sanddab, horneyhead turbot (*Pleuronichthys verticalis*), and fantail sole (*Xystreurys liolepis*), are more common at deeper inner shelf depths ranging from –10 to –24 meters (-30 to –80 feet) MLLW (MEC, 2002).

The sandy intertidal is also used by a nearshore fish, the California grunion (*Leuresthes tenuis*) which lays its eggs in the high intertidal zone between March and August. During the grunion spawning season, eggs and developing embryos are buried in the sand to incubate between the highest tides of each month, at the full and new moon (Martin 2006). The eggs incubate a few inches deep in the sand and hatch approximately 10 days later during the next series of high tides (Chambers Group 2002). Grunion are known to spawn on the beach in the vicinity of San Clemente Pier (K. Martin, Pepperdine University, pers. comm., 2007).

Hard Substrate Communities

The area at Mariposa Point consists of sensitive rocky intertidal habitat, which supports a relatively diverse invertebrate community on individual boulders as well as on the surfaces of the low-lying platform reefs (CRM, 2000). The high intertidal or splash zone is characterized by barnacles (*Cthamalus* spp.), limpets (*Lottia* spp., *Collisella* spp.), and periwinkle snails (*Littorina* spp.) (MEC, 2002). The California mussel (*Mytilus californianus*), aggregating anemone (*Anthopleura elegantissima*), giant green anemome (*A. xanthogrammica*), chitons (*Mopalia muscosa* and *Nuttallina californica*), barnacles (*Balanus* spp.), hermit crabs, and snails (*Acanthina* spp.) are commonly observed throughout the middle and low intertidal zones (CRM, 2000; MEC, 2002). Although not common, the reef-building sandcastle tube worm (*Phragmatopoma californica*) was also found around the base of several boulders in the middle intertidal zone (CRM, 2000). The low intertidal zone and the adjoining subtidal rocky habitat, including the apex of the offshore reefs, support a diverse assemblage of invertebrate species. Typical reef organisms observed during the June 2000 survey conducted by CRM included mussels (*Mytilus californianus* and *M. edulis*) gorgonians (*Muricea californica* and *M. fructicosa*), keyhole limpet (*Megathura crenulata*), purple and red sea urchin (*Strongylocentrotus purpuratus* and *S. franciscanus*), California sea cucumber (*Parastichopus californicus*), Kellet's whelk (*Kelletia kelletii*), and sea stars (*Pisaster brevispinus* and *P. giganteus*). Other species expected to occur include the California sea hare (*Aplysia californica*), as well as various crabs and marine snails (MEC, 2002).

Up to ten species of fish utilize the low to minus tidal zones of rocky intertidal habitats in the SCB (MEC, 2002). Wooly sculpin (*Clinocottus analis*) is one of the more commonly encountered fish species in tidepools, but juvenile opaleye (*Girella nigricans*), rockpool blenny (*Hypsoblennius gilberti*), spotted kelpfish (*Gibbonsia elegans*), and California clingfish (*Gobiesox rhessodon*) may also be present (Cross and Allen, 1993).

The June 2000 survey also identified spotted sand bass (*Paralabrax maculofasciatus*), kelp bass (*P. clathratus*), senorita (*Oxyjulius californicus*), bat ray, and black surfperch (*Embiotoca jacksoni*). Other fish that are commonly associated with nearshore reef habitats with developed stands of perennial vegetation above one meter (3 feet) in height may also be present within the project area, including barred sand bass (*P. nebulifer*); shiner, walleye, and dwarf surfperches (*Embiotocidae*); California sheephead (*Semicossyphus pulcher*); garibaldi (*Hypsypops* *rubicundus*); jack mackerel (*Trachurus symmetricus*); giant kelpfish (*Heterostichus rostratus*); painted greenling (*Oxylebius pictus*); and halfmoon (*Medialuna californiensis*) (MEC, 2002; Thomson et al., 1993). The dominant fish species in the offshore kelp beds, approximately 650 meters (2,000 feet) offshore of Mariposa Point (Washrock Reef) and 1,220 meters (4,000 feet) from North Beach at depths between –7 to –8.5 meters (-23 to –28 feet) MLLW, are expected to be surfperch (*Embiotocidae*); rockfish (*Sebastes* spp.); and wrasses (*Labridae*) (e.g. sheephead, senorita, and rock wrasse (*Halichoeres semicinctus*)).

Birds

A diverse variety of resident and migratory seabirds and shorebirds are commonly observed along southern California beaches and offshore waters. Seabirds such as pelicans, terns, and cormorants forage for fish in the Nearshore Ocean. Sandy upper tidal beaches are utilized by gulls and shorebirds as roosts. Gulls feed on fish and invertebrates, particularly near the edge of the kelp canopy. Shorebirds probe for invertebrates in the damp sands of the middle and low intertidal zones, and some species also forage for small fish and invertebrates in the rocky intertidal. Kelp and surfgrass that have washed ashore harbor invertebrates and, thus provide good foraging areas for gulls and shorebirds.

The seabirds that are most commonly observed along the beaches and ocean waters offshore of Orange and San Diego Counties include Heerman's gull (*Larus heermanni*), ringed-billed gull (*L. delawarensis*), western gull (*L. occidentalis*), California brown pelican (*Pelecanus occidentalis californicus*), surf scoter (*Melinita perspicillata*), terns (*Sterna* spp.), grebes (*Podicipedidae* spp.), double-crested (*Phalacrocorax auritus*), Brandt's (*P. pencillatus*), and pelagic (*P. pelagicus*) cormorant (Chambers Group, 2002; MEC, 2002). Commonly observed shorebirds include black turnstone (*Arenaria melanocephala*), marbled godwit (*Limosa fedoa*), sanderling (*Calidris alba*), whimbrel (*Numenius phaeopus*), willet (*Catoptrophorus semipalmatus*), dunlin (*Calidris alpina*), western sandpiper (*Calidris mauri*), and least sandpiper (*Calidris minutilla*) (Chambers Group, 2002; McConnaughey and Mcconnaughey, 1988; MEC, 2002).

Marine Mammals (Non-Endangered)

The marine mammals that occur in the Southern California Bight have been described in detail in previous studies and environmental documents (e.g., Bonnell et al. 1981, 1983; Bonnell and Dailey 1993; Dohl et al. 1981, 1983; ADL 1984; Barlow 1995; Barlow et al. 1995, 1997; Barlow and Gerrodette 1996; Koski et al. 1998; DeLong and Melin 2000; Stewart and Yochem 2000). Although as many as 36 species of marine mammals inhabit or visit the Southern California Bight, including 6 species of pinnipeds (seals and sea lions), 29 species of cetaceans (whales, porpoises, and dolphins), and the sea otter, only about 4 species are expected to occur in the nearshore waters of the San Clemente study area on a regular basis, and are described below. Other species may also occur in the study area on an irregular basis.

Sea lions

The California sea lion (*Zalophus californianus*) ranges from British Columbia to Mexico. The current U.S. population size is estimated at 237,000-244,000 animals (Carretta et al. 2007). In the Southern California Bight, California sea lions currently breed on four islands: San Miguel, San Nicolas, Santa Barbara, and San Clemente.

Harbor seals

Harbor seals (*Phoca vitulina*) range from Mexico to the Aleutians. The North Pacific population is centered in Alaska (Hoover, 1988), and about 34,233 harbor seals are found in California (Carretta et al. 2007). Peak harbor seal populations on land occur during the species' spring breeding and pupping season and early summer molt. Harbor seals forage relatively close to shore and occasionally "haul out" onto land at various times of the day for an indefinite period of time (Seaworld 2002).

Gray Whale

The California gray whale (*Eschrichtius robustus*) population migrates through southern California waters twice a year on its way between Mexican breeding lagoons and feeding grounds in the Bering Sea. The southbound migration through the Southern California Bight begins in December and lasts through February; the northbound migration is more prolonged, lasting from February through May with a peak in March (Bonnell and Dailey 1993). Gray whales are generally absent from southern California waters from August through November. Migrating gray whales generally travel along the nearshore shallow continental shelf within 2 mi (3 km) of the shoreline over most of the route (Graham 1989). This proximity to shore makes gray whales vulnerable to numerous threats by human activities, including industrial activities, oil exploration and extraction, shipping traffic, pollution, and whale-watching tourism (Crane 1992).

Bottlenose Dolphin

Coastal bottlenose dolphins (*Tursiops truncatus*), the population most likely to occur in the study area, generally are found within approximately 1-2 km (1 mile) of shore, primarily from Point Conception south into Mexican waters. The coastal population appears to form small resident groups that range along the coastline, especially off Orange and San Diego counties (Weller and Defran 1989). The coastal population is estimated at about 323 animals (Carretta et al. 2007).

2.8.3 Threatened and Endangered Species

In Section 7(c) of the FESA, as amended, requires that a federal agency request from the appropriate authority a list of threatened and/or endangered species present in an area of a proposed major federal action.

Because of a lack of natural terrestrial habitat within the project footprint, sensitive terrestrial plants and animals would not be expected to occur in the project area. The EIS lists sensitive species with the potential to occur on the beach in the project area or offshore in the vicinity of the borrow sites and/or the beach fill site. Potential impacts to these species are addressed in Section 4.4.3 of the joint EIS/EIR.

2.8.4 Water Quality

Water quality is typically characterized by salinity, pH, temperature, clarity, and dissolved oxygen (DO). **Table 2-11** characterizes the overall water quality parameters for the project site.

Table 2-11 Water Quality Characteristics

Parameter	Range
Salinity (ppt)	22 to 34
Surface Temperature (F)	57.2 to 67.1
PH	7.4 to 7.6
Clarity (feet)	13 to 15
D.O. (mg/L)	6.5 to 10

- Water temperatures range from approximately 14°C (winter minimum) to 22°C (summer maximum). During the summer, surface water temperatures are up to 10°C warmer than those in deeper waters.
- Near shore salinity is generally uniform, from approximately 33 to 34 ppt. Seasonally, the near-surface salinity can decrease near the Prima Deshecha & Segunda Deshecha Watershed following storm-related discharges of freshwater and/ or (historically) intermittent discharges of sewage into the river.
- Dissolved oxygen concentrations typically lie between approximately 6.5 and 10 milligrams per liter (mg/L), but may drop below approximately 5 mg/L at depths of 60 meters.

Light transmittance (indicating water clarity) has been measured at approximately 4 to 4.5 meters (13 to 15 feet). Some reduction was associated with storm activity, particularly in shallower, near shore waters. Both light and nutrients are needed to support photosynthesis by attached and planktonic plants.

Nutrient concentrations are expected to be similar to that elsewhere in the Southern California Bight: Nitrates at approximately 5 to 200 nanomoles per liter; phosphates at approximately 100 to 500 nanomoles per liter; and ammonium at approximately 300 nanomoles per liter. Discharges from the Prima Deshecha & Segunda Deshecha likely represent an important seasonal source of nutrients to nearshore waters. Upwelling events also contribute nutrients to surface waters.

Several storm drains have outlets onto beaches within the study area and its vicinity. The City of San Clemente and the County of Orange have been required to monitor bacterial levels at storm drain outlets and in the adjacent surfzone since January 2003 as part of the Coastal Storm Drain Outfall Monitoring (CSDM) Program (County of Orange et al. 2003). For the CSDM Program, monitoring was conducted on both the discharge from the storm drain and the surfzone 23 meters (25 yds) up-coast and 23 meters (25 yds) down-coast of the storm drain to ocean interface. Grab samples were collected weekly for the analysis of total coliform, fecal coliform, and Enterococcus bacteria. An estimate of the flow rate from the storm drain was made and the temperatures of the storm drain discharge and the surf zone down-coast were measured (County of Orange et al. 2006).

During the monitoring period of July 2005 through June 2006, bacteria levels at nine out of ten monitoring stations within the study area or within two miles of its boundaries met California Ocean Plan standards in 90 percent or more results. The tenth monitoring station, located at Poche Beach approximately two miles north of the study area, exceeded Ocean Plan standards in 10-40 percent of results during the monitoring period (County of Orange et al. 2006). Poche Beach is at the outlet of the Prima Deshecha Flood Control Channel.

2.8.5 Sediment Quality

The sampled materials were generally fine-grained sands with local silty intervals and minor amounts of shell fragments. Significant gravel/cobble beds and lenses were encountered throughout the area, but the thicknesses generally averaged 0.65 meters (2 feet) or less. Shell and shell fragments were encountered throughout the area. Appendix E of the EIS/EIR lists the cross sections through the borrow area and presents results of the geotechnical explorations conducted at the borrow sites. In order to determine the compatibility of dredged material with the receiving beach, gradation analysis of the onshore and offshore beach profiles is required. The average median grain size diameter (D_{50}) of the proposed borrow is relatively consistent, varying from 0.21 to 0.23 mm, which is slightly coarser than the average D_{50} of 0.17 mm for the entire San Clemente shoreline project.

Chemical testing of the proposed borrow area offshore Oceanside has been done by the San Diego Association of Governments (SANDAG, 2000) and the USACE (2003). The analytical results are summarized and compared to the Sediment Quality Guidelines (SQGs) in the EIS document. The Sediment Quality Guidelines (SQGs) are based on Puget Sound Dredged Disposal Analysis (PSSDA) and NOAA guidelines. The PSSDA screening level (SL) identifies the concentration below which sediment is expected to have no unacceptable adverse effects. The higher value is the maximum level (ML) above which effects are likely. The NOAA published effects-based sediment quality values for evaluating the potential for constituents in sediment to cause adverse biological effects are referred to as Effects Range-Low (ER-L) and Effects Range-Median (ER-M). Sediment samples in which all chemical concentrations are below ER-L values are not expected to be toxic. Generally, effects may occasionally be expected when chemical concentrations occur between ER-L and ER-M values. The probability of toxicity is expected to increase with the number and level of exceedances above the ER-M. These values are not accepted standards or criteria, but rather provide effects-based guidelines. Since SQGs have not been developed for southern California, these are used as an initial, informal evaluation to determine the need for further Tier II or Tier III testing.

The total organic carbon concentration was 0.08 percent in the SANDAG samples and 0.15 percent in the USACE samples. Contaminant concentrations of metals, pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), phthalates, and phenols were non-detectible to low and well below all the thresholds in the SQGs for both sample sets. No dichlorodiphenyltrichloroethane (DDT) or chlorinated pesticides were detected in the samples. The bulk chemistry data indicated that chemicals detected within the sediments at the proposed borrow site are at very low levels and do not exceed the SQGs. Therefore, based on the geotechnical information and that of the borrow source, the borrow site sediments are considered suitable for placement at the receiving beach at San Clemente.

2.8.6 Ambient Noise and Air Quality

Dominant noise sources include waves, beach recreation activities, and vehicle noise on adjacent roads. The sound of wave action will vary with factors including wave height, period, frequency, angle of attack, season, and wind conditions. Background noise levels are generally low, due to the limited traffic and residential nature of the area. Two major sources of noise exist in the San Clemente Beach region: rotorcraft air operation training at Camp Pendleton, south of the southernmost region of the San Clemente project study area, occurring periodically throughout the year; and temporary construction activities. Noise levels occasionally impair normal conversation.

The most important climatic and meteorological characteristics influencing air quality in the study area are persistent temperature inversions, predominance of onshore winds in Orange County, mountain ridge and valley topography, and prevalent sunlight. Air quality is evaluated by measuring ambient concentrations of pollutants that are known to have deleterious effects. The degree of air quality degradation is then compared to ambient air quality standards (AAQS). Annual ambient air quality monitoring has been conducted at two locations (El Toro and Costa Mesa) approximately 20 miles north of the project area between 1992 and 1997. Detailed monitoring results can be found in the EIS/EIR. The high frequency of southwest to northwest sea breezes usually occur during the daytime for most of the year and transports air pollutants away from the coast toward the interior regions in the afternoon hours. As a result, air quality conditions along the coast, such as Newport Bay, are typically better than the conditions presented for the interior Costa Mesa and El Toro Monitoring Stations.

In addition to criteria pollutants, other regulated pollutants include toxic air contaminants (TACs), which are suspected or known to cause cancer, genetic mutations, birth defects, or other serious illnesses in exposed people. (The TACs are not regulated by the NAAQS or CAAQS, but are addressed by the National Emission Standards for Hazardous Air Pollutants [NESHAPs] and Title III of the 1990 Clean Air Act Amendments). Generally, TACs behave in the atmosphere in the same way as inert pollutants. The level of emissions at the source determines the concentrations of both inert and toxic pollutants. Thus, impacts from toxic pollutant emissions tend to be site specific and their intensity is subject to constantly changing meteorological conditions. The worst meteorological conditions that affect short-term impacts (low wind speed, highly stable air mass, and constant wind direction) occur relatively infrequently.

2.8.7 Cultural Resources

Named after one of the offshore southern Channel Islands, San Clemente Island, the city was founded by a former mayor of Seattle, Ole Hanson, in 1925 (Brock 1985). San Clemente was among the first master planned communities built from totally open land in the United States. Before erecting a single structure on the rolling coastal hills, Ole Hanson laid out an expansive plan based on the Spanish Colonial architectural style including restaurants, a clubhouse, residences, public parks, a public pool, a fishing pier, and even equestrian trails. Hanson's residential community, promoted as "The Spanish Village," featured wide, meandering streets that conformed to the contours of the hills, houses situated to provide an ocean view, and mandatory white stucco exteriors and red tile roofs for every building. San Clemente was incorporated in 1928, and grew rapidly until the Depression, when development halted. The growth rate picked up again during the 1950s, and was later boosted by construction of the San Diego Freeway.

Today, the Spanish Village by the Sea is more heterogeneous than Hanson had envisioned, but historic homeowners and current planning and development all reflect increasing esteem for his red-roofed, white-walled Spanish architecture dream. Historic homeowners must abide by city codes that protect the aesthetic spirit and style of early San Clemente.

A records and literature search was completed at the South Central Coastal Information Center at California State University, Fullerton to determine if prehistoric or historic sites had been previously recorded within the project area. While no sites have been recorded within the project area, three shell middens and an isolate have been recorded adjacent to the project's eastern boundary (**Table 2-12**). In addition, the Historic Resources Inventory (HRI), which includes the National Register (NR), California Register, State Historic Landmarks, Points of

Historic Interest and all properties evaluated for the NR, identified two properties located in the project vicinity: Casa Romantica (located in Reach 6, added to the NR in 1991; No. 91001900) and San Clemente Beach Club (located in Reach 9, added to the NR in 1981; No. 81000164).

No recorded archaeological sites or historic properties have been recorded within the project area.

Table 2-12 Summary of Recorded Archaeological Sites

Site No.	Description	Source & Date
CA-Ora-101	Shell Midden	Smethe 1954
CA-Ora-102	Shell Midden, village site, manos	Waldeck 1948
CA-Ora-103	Shell Midden, hammerstone, manos	Waldeck 1948
30-100074	Basalt dentidular flake (Isolate)	Maxon 1996

The project area has been extensively disturbed by urban development. The above listed archaeological and historical sites will not be impacted by the proposed project. Because the southern California coast is rich with cultural history, discovery of buried sites is always a possibility. If cultural resources are located, the Corps must be notified immediately.

2.8.8 Aesthetics

The views to the west of the entire project site are of the Pacific Ocean. Nearly the entire project site is lined with palm trees beachside of the railroad tracks. At the northern portion of the project site, the project site is viewable from adjacent beach areas, residential areas located atop the bluffs adjacent to the beach, visitors at Linda Lane Park, and the Pier. At the center of the project site, the project site is viewable from the Pier, from commercial businesses, located both on the Pier and east of the railroad tracks, residences, and visitors at Parque del Mar and Linda Lane Park. At the southern end of the project site, the project site is viewable from adjacent beach areas, the parking meters at West Paseo de Cristobal, pedestrians on the overpass, residential areas located atop the bluffs adjacent to the beach, and the Pier. In addition, the entire project site is visible to nearshore and offshore recreational users, as well as to passengers on passing trains.

The California Coastal Act includes the protection of the scenic and visual qualities of coastal areas, including the protection of views to and along the ocean, minimization of the alteration of natural landforms, and necessary actions to restore and enhance visual quality in visually degraded areas. The project is consistent with Policy 10.2.5 of the City of San Clemente General Plan Natural and Historic/Cultural Resources Element, which promotes development of programs "that will preserve and maintain the physical features of the coastal zone including bluffs, canyons, and beaches."

2.8.9 Environmental Regulations

As discussed in the EIS Volume I, **Table 2-13** below lists both the Federal and State environmental regulations that apply to the recommended alternative and study area that will be observed.

Table 2-13 Federal and State Environmental Regulations

Title of Regulation or Public Law	US CODE
FEDERAL ENVIRONMENTAL REGULATIONS	
National Environmental Policy Act of 1969 (Public Law 91-190) as amended	*42 USC 4321 et seq.*
ER-200-2-2, 33 CFR 230, March 1988	*33 CFR 230*
2.8.10 Coastal Zone Management Act of 1972 and California Coastal Act of 1976	*16 USC 1451 et seq.*
Clean Water Act of 1977 (Public Law 95-217)	*42 USC 7401 et seq.*
Rivers and Harbors Act of 1899	*33 USC 401-413*
Fish and Wildlife Coordination Act of 1958 (Public Law 85-624, 16 USC 661-666©)	*16 USC 661*
Federal Endangered Species Act of 1973	*16 USC 1531*
Magnuson-Stevens Fishery Management and Conservation Act, as amended 1996 (Public Law 104-267)	*16 USC 1801*
Marine Mammal Protection Act of 1972	*16 USC 1361*
Migratory Bird Treaty Act, as amended (16 USC 703-711)	*16 USC 703-711*
Executive Order 11990	
Executive Order 11991	
National Historic Preservation Act of 1966, as amended (16 USC 479)	*16 USC 470*
Clean Air Act of 1972	*42 USC 7401 et seq.*
Executive Order 12088	
Executive Order 12898	
Executive Order 13045	
Federal Water Project Recreation Act (Public Law 89-72), July 9, 1965	*16 USC 4601*
STATE ENVIRONMENTAL REGULATIONS	
California Environmental Quality Act (Public Resources Code, Sections 21000-29 21177)	
California Coastal Act of 1976, as amended	
Porter-Cologne Water Quality Control Act of 1966 (California Water Code §§13000-13999.10)	
California State Lands Commission (Sections 6216 and 6303)	
California Endangered Species Act (California Fish and Game Code Sections 2050-2116)	
LOCAL ENVIRONMENTAL REGULATIONS	
South Coast Air Quality Management Plan (AQMP); South Coast Air Quality Management District (SCAQMD) and Southern California Association of Governments (SCAG)	

2.9 Economic Conditions

2.9.1 Historic Development

The City of San Clemente, founded by Ole Hanson, consisted of 8 km^2 (3 mi^2) between the state highway and the ocean, located 106 km (66 miles) from both Los Angeles and San Diego. Despite much skepticism from realtors and other developers, Hanson moved forward and laid out his planned community using airplane photographs, and in December 1925, he began selling lots. Over a six month period, 1,200 lots were sold, and by November 1926 the building program was calling for completing 16 buildings every week. As part of his development program, Hanson deeded to the residents of the village, 915 meters (3,000 ft) of beach, the Community Clubhouse, beach Club, Fishing Pier, and golf course. In three and a half years, San Clemente had grown to the point where it was generally conceded to be the wealthiest city per capita in America. In 1928, the City of San Clemente was incorporated and received title to the water system, the beach club, the Pier, 915 meters (3,000 ft) of beach, 27 km (17 miles) of riding trails, the community center, the school and parks for $1.

2.9.2 Socio-economic Profile

Population

The majority of Californians live in Southern California. The California Department of Finance (CDOF) estimates the population of Orange County at 3,121,251 as of January 1, 2008, with the City of San Clemente having a population of 67,892 (Economics Appendix). Orange County's population accounts for 8.2% of the State's 38 million inhabitants. San Clemente is comprised of 46 km^2 (18 square miles).

Using the U.S. Bureau of Economic Analysis projection data for the State of California, the state is expected to experience a population increase of more than 28% by 2025, a considerably faster rate of growth than the United States (23%).

The City of San Clemente has experienced rapid growth since 2000. According to CDOF statistics, the City of San Clemente has grown from 49,936 residents in April of 2000 to its current figure of 67,892, an increase of 36.0%. The median age of the population of San Clemente is 38 years. The median age in Orange County is 31, and the median age for California is 33.6. Orange County has a population of 281,782 of people over the age of 65, which is 9.9% of the population.

Using 2000 Census reports, the population of the city of San Clemente is 87.9% white. Minority populations include: Asian (2.6%), American Indian and Alaskan Native (0.6%), African American (0.8%), Native Hawaiian (0.18%); and other (5.1%). Approximately 15.9% of the population is of Hispanic or Latino heritage. There are 19,395 households and the average household size is 2.56 persons.

Employment

Figure 2-15 and **Table 2-14** indicate the predominant sectors of employment for residents of the study area, according to the U.S. Census Bureau's *Profile of Selected Economic Characteristics (2000)*. Important employment sectors include: management and professional services, production and transportation occupations, service occupations, and construction and maintenance.

In 2002 the value of agricultural production was $344.3 million. That ranks the county 19th in the state of California. Leading agricultural commodities include nursery stock and cut flowers, strawberries, tomatoes, peppers, and avocados.

In Orange County, the unemployment rate in March 2009 was 8.5%, up from 4.5% in March 2008. The city of San Clemente has a rate of 6.9%, which is much lower than the rates in both the county and the state (11.2%).

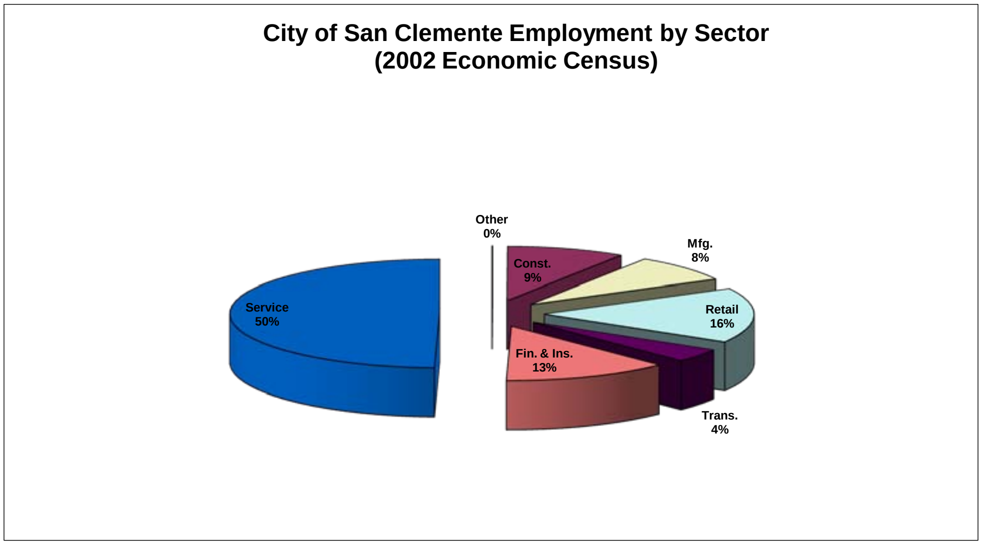


Figure 2-15 San Clemente Employment

Table 2-14 Employment by Industry (2007)

Industry	San Clemente	Orange County	California
Farming & Mining	14	5,525	326,033
Construction	2,752	111,018	1,304,774
Manufacturing	2,430	205,584	1,770,742
Wholesale & Retail	4,933	220,229	2,466,785
Transportation & Warehousing	1,214	50,199	766,388
Finance & Insurance	3,859	183,676	1,745,598
Service	14,970	680,228	8,184,668
Total	30,172	1,456,459	16,564,988

Income

Table 2-15 summarizes pertinent information regarding income and effective buying power of households in the study area. Among the most common occupations are: sales and office occupations, 28.5%; management, professional, and related occupations, 43.8%; production, transportation, and material moving occupations, 4.6%; service occupations, 15.2%; and construction, extraction, and maintenance occupations, 7.9%. Approximately, 75% of the people employed were private wage and salary workers. In 2001, 10% of people were below the poverty line. Twelve percent of related children under 18 were below the poverty level, compared with 13% of people 65 years old and over. According to the, *2005-2007 American Community Survey,* the median income of households in Orange County was $82,842 in 2007 dollars with mean household income at $109,987; 82% of the households received earnings and 17% received retirement income other than Social Security, and 25% of the households received Social Security. The average income from Social Security was $16,133. As shown in Table 2-14, the per capita income and median household income, in the study area are substantially higher than figures for the county and state.

Table 2-15 Household Income (2007)

	San Clemente	Orange County	California
Households	22,971	972,040	12,140,888
Less than $15,000	1,524	71,483	1,314,868
$15,000 - $24,999	1,561	68,436	1,184,362
$25,000 - $34,999	1,700	76,620	1,163,795
$35,000 - $49,999	2,156	115,896	1,595,293
$50,000 - $74,999	3,536	173,926	2,187,062
$75,000 or more	12,494	465,679	4,695,508
Median Household Income	**$82,842**	**$71,601**	**$58,361**
Per Capita Income	**$43,031**	**$32,890**	**$28,049**

2.9.3 Land Use

San Clemente is comprised of 46 km^2 (18 square miles). The beach characteristics for each reach are described in Section 2-1. Beach facilities are primarily located in reaches 6 and 7, provide basic services, and enhance the recreation experience for users at San Clemente Beach. **Table 2-16** shows the square footage and depreciated replacement value of public buildings that are vulnerable to wave attack and erosion of the shoreline. The building costs for the structures along the shoreline are significantly higher than inland, due to costs of protection (sheet pile and caissons) and the building materials needed for an ocean environment. Also, the building costs were inflated due to high costs providing utility services to the building. The estimates of depreciate replacement values for structures were based on Marshall & Swift and the Cost Engineering Appendix.

Table 2-16 Depreciation Replacement Values of Facilities on Public Beach

Facility	Area m^2 (ft^2)	Base Replacement Value	Depreciated Structure	Depreciated Contents
Marine Headquarters	527 (5,675)	$2,605,000	$1,953,800	$722,900
North Beach Concession & Restroom	89 (960)	$443,400	$332,500	$123,000
Linda Lane Restroom	61 (660)	$285,700	$142,900	$0
Picnic Shelter #1	46.5 (500)	$27,900	$20,900	$0
Concession South Pier	74 (800)	$246,100	$184,600	$68,300
Pier Restroom	61 (660)	$298,300	$223,700	$0
Picnic Shelter #2	46.5 (500)	$27,900	$20,900	$0
Restroom @ T-Street Beach	93 (1,000)	$392,900	$294,700	$0
Concession @ T-Street Beach	44.6 (480)	$231,200	$173,400	$64,200
Restroom south T-Street	44.6 (480)	$392,900	$196,500	$0
Total	**1,087 (11,715)**	**$4,951,300**	**$3,543,900**	**$978,400**

2.9.4 Transportation

In 2008, there were over 2,500,000 vehicles registered in Orange County. The county has over 2,700 km (1,700 miles) of streets, roads, and highways. Major interstate highways servicing the county and study area include Interstate 5 (north to south) and Pacific Coast Highway both running north and south. There are other freeways connecting cities notably I-405 (north and south); 91, and 73 running east and west.

Roughly parallel to the coastline, the North/South arterial freeway, Interstate 5, is less than 1.2 km (0.75 mi) inland from the beach and serves San Clemente with five freeway exits. The Pacific Coast Highway, runs north from San Clemente, providing local access and scenic travel along the coast. Six major airports are within 120 km (75 miles) of San Clemente. The closest, John Wayne Airport in Santa Anna, is 45 km (28 miles) away, and is served by American, Delta, Southwest, United, and other domestic carriers.

San Clemente's railway stop is at the foot of Avenida Del Mar, directly opposite the Municipal Pier. Amtrack's Pacific Surfliner train stops in San Clemente several times a day as it travels between San Luis Obispo and San Diego. Orange County has a Metrolink train system that provides commuters with access to Los Angeles, Riverside, San Bernardino, Ventura, and North San Diego counties. The seven-year old commuter train operates a total of 126 daily trains running over 416 miles of track.

While the majority of visitors to San Clemente's beaches travel by car, more than 10% of overnight guests fly to the area, and a significant number of local visitors walk to the beach or come by train. **Table 2-17** lists the principle modes of travel by frequency for all visitors who participated in the survey, based on beach surveys (Office of Management and Budget approved) taken in 2002.

Table 2-17 The Method of Travel to San Clemente's Beaches

Mode of Transport	Frequency (%)
Car	71%
Airplane	13%
Walk	8%
Train	5%
Other/NA	3%

2.9.5 <u>Railroad Corridor</u>

The LOSSAN corridor (Los Angeles to San Diego) is the only railroad link between San Diego and the rest of the United States for passenger and freight railroads to operate, including military operations. This corridor is a major transportation link for passenger traffic, second only to the Washington DC to Boston corridor in terms of Amtrak train density and ridership.

History of the Railroad

In 1882 the Atchison, Topeka, and Santa Fe Railway Company (ATSF) constructed the rail line connecting San Diego to San Bernardino, but this line was abandoned after two severe flood episodes that damaged the route. The ATSF constructed the LOSSAN corrider in 1888. The railroad line connected the cities of Fullerton and San Diego.

During the 1980's ATSF, Caltrans, Amtrak and Los Angeles, Orange and San Diego counties shared the cost ($79 million) of the LOSSAN Rail Corridor Rehabilitation project. The project included replacement of the 50-year old jointed rail with new, heavier continuous-weld-rail; new wood railroad ties; installation or replacement of some power switches; and surfacing. In addition, since the 1980's the railroad and government agencies have spent $852 million in improving the infrastructure along the LOSSAN corridor.

The ATSF maintained and operated the LOSSAN corridor until 1993 when it was sold to the Orange County Transportation Authority (OCTA). The purchase by OCTA was funded by bond proceeds, the passage of propositions 108 and 116 in 1990, and by the proceeds from local transportation sales tax measures. Conditions of the purchase from the ATSF included the obligation to continue operation of ATSF and Amtrak trains, and the protection of utilities within the right of way. OCTA has assigned the maintenance of the line and operation of commuter trains to the Southern California Regional Rail Authority (SCRRA). This maintenance activity includes track and tie inspection and the periodic repairs. Also, there is on-going vegetation control and debris removal along the right-of-way, as well as periodic replacement of rip rap to protect the track bed from wave action.

Existing Operations

In 1996 the ATSF merged into a new corporation, the Burlington Northern and Santa Fe Railway (BNSF). Currently, this line connects with other railroad lines in San Diego. Also, this line connects to the Tijuana and Tecate areas of Baja California Norte (Mexico).

When Amtrak took over passenger service in 1971, only three daily "San Diegan" passenger train round trips were being operated. Eighteen San Diegan trains currently operate daily along this route, nine in each direction.

In 1992 Metrolink commuter rail service began on six local corridors centering in Los Angeles and Orange Counties. Metrolink operates 19 trains per day on the Orange County route. An average of 377 passengers board at the Oceanside and San Clemente stations daily (June 2000).

The Amtrak's Pacific Surfliner provides service to the San Clemente station. The Surfliner provides service from San Diego to San Luis Obispo. The service carried more than 1.7 million passengers in FY 2002. The Pacific Surfliner Corridor serves Southern California's key coastal population centers and connects two of the most congested regions in the country – Los Angeles and San Diego.

The BNSF operates, on average, 4 daily trains. Trains operating during the day average 4,800 tons, which is approximately 60-65 trains cars in length. Trains operating at night are typically auto trains (the trains are approximately 1980 m (6,500 ft) in length). During periods of peak freight activity, BNSF may run 6 trains a day on this segment of the LOSSAN corridor. In addition to general freight, the line handles fuel gas, bulk chemical shipments to the Port of San Diego (principally potash), feed grain, automobile, lumber, and transportation, construction, and military equipment. Also, this line serves the Camp Pendleton Marine Corps Base, the Miramar Naval Air Station, the Southern California's San Onofre nuclear plant, and the San Diego Unified Port District.

Future of the Railroad

For the year 2020 SCRRA forecasts 58 trains carrying 17,760 passengers per weekday and Amtrak forecasts 32 trains carrying 5,760,000 annual passengers (averages 15,781 per day but actually peaks on Friday, Saturday, and Sunday).

Freight service is also expected to grow in the future. Projections by San Diego Association of Government show variable projections indicating freight cargo movements along the LOSSAN corridor increasing 20 to 50 percent by the year 2022. The estimates could increase larger depending on industry growth along the United States-Mexico border related to the effectiveness of NAFTA and the success of the maquiladoras and associated industries.

High Speed Rail Plan

According to the U.S. Department of Transportation's 2009 Record of Decision, a dedicated high speed transit (HST) corridor with separate tracks for HST and conventional rail service is impracticable in the severely constrained LOSSAN corridor. Constructing an HST would create operational conflicts with existing, conventional passenger and freight rail in the corridor, and significant environmental impacts in the narrow LOSSAN right-of-way which traverses sensitive natural areas along the southern California coast. The Federal Railroad Administration selected a corridor from Los Angeles to Ontario and then along the I-15 to San Diego for the dedicated statewide HST system. Conventional rail was therefore determined to be the only practicable rail technology within the LOSSAN corridor south of Irvine.

2.9.6 Beaches in San Clemente

San Clemente's beaches are sandy and relatively narrow. Except for a pedestrian overpass at the end of Avenue Esplanade and a tunnel under the tracks at the north end of Plaza la Playa, visitors must cross the railroad tracks to visit the beach. There are three jurisdictions responsible for maintaining the recreation use of the study area beaches including: San Clemente State Beach, San Clemente's City Beach including North Beach, and a private beach adjacent to the Shorecliff Mobile Home Park. The State Beach extends for 2.4 km (1.5 miles) north from San Mateo Point to Avenida Calafia. The City Beach is a little more than 4 km (2.5 miles) long, from Avenida Calafia up to Avenida Pico, at the Ole Hanson Beach Club. The private beach is approximately 1.2 km (0.75 miles) in length from Avenida Pico to Camino Capistrano.

Amenities at the State Beach are relatively sparse, but include restrooms, outdoor showers, camping, picnic areas, a snack bar, and parking. The southern part of San Clemente's City Beach (at T street and south) is similar to North Beach in terms of amenity levels. It attracts locals, including surfers. North Beach, mainly frequented by locals, provides significantly fewer amenities than the main City beach area, though it does offer lifeguard services, rest rooms and a few other minor facilities.

Walk-in access to both the City Beach and the State Beach is free. To park, both local and non-local visitors pay a fee of $5.00/vehicle for day use at the State Beach, and an estimated 30% of drivers visiting the City Beach use metered parking at the rate of $1.00/hour. Campers at the State Beach staying in one of the 160 campsites pay $12/day, which includes parking and access to the beach.

2.9.7 San Clemente Municipal Pier and Pedestrian Beach Trail

San Clemente's Municipal Pier dominates the central area of the City Beach (Reach 6). It offers fishing, restaurants, and some other shops. Restrooms and a food concession are located near the base of the Pier. Additional shops and restaurants, metered parking and a grassy picnic area with picnic tables are available within a two minute walk from the Pier. Restrooms, beach showers, water fountains, picnic tables, fire-pits, and a volleyball court are also available at various other sites along the beach. Surfing and boogie-board equipment is available for rental nearby. Amenities at the State Beach are sparser, but include restrooms, outdoor showers, camping, picnic areas, a snack bar, and parking.

The San Clemente Pedestrian Beach Trail is a multi-use pedestrian beach trail (**Figure 2-16**) that has recently been completed at a cost of $11.8 million. The 4 km (2.5 mile) trail spans from North Beach to Calafia, and is located at the base of coastal bluffs and the beach within the right of way of the existing rail corridor. The trail consists of a 1.5 – 3 meter-wide (5 to 10 ft) at-grade multi-use path, approximately 260 meter (850 ft) long, 2.4 meter (8 ft) wide elevated walkway at Mariposa Point, three short bridges to cross drainage channels at Trafalgar, Riviera and Montalvo, improvements to existing El Portal, Montalvo and Mariposa for pedestrian under rail crossings and pedestrian at grade crossings at Dije, El Portal, Corto Lane, "T" Street South and Lost Winds for beach access. This new pedestrian trail addresses existing safety and adequacy issues with existing opportunities for public access to and along the coast in San Clemente. Overall safety will improve for pedestrians who cross the train tracks to access the beach in south San Clemente. The San Clemente Pedestrian Beach Trail will also serve to form a significant link in the statewide Coastal Trail, making more of the beach accessible to the public by creating a coordinated access system of regional and statewide significance.

Construction of the trail on the oceanside of the railroad tracks will subject the trail to erosion and wave damage.

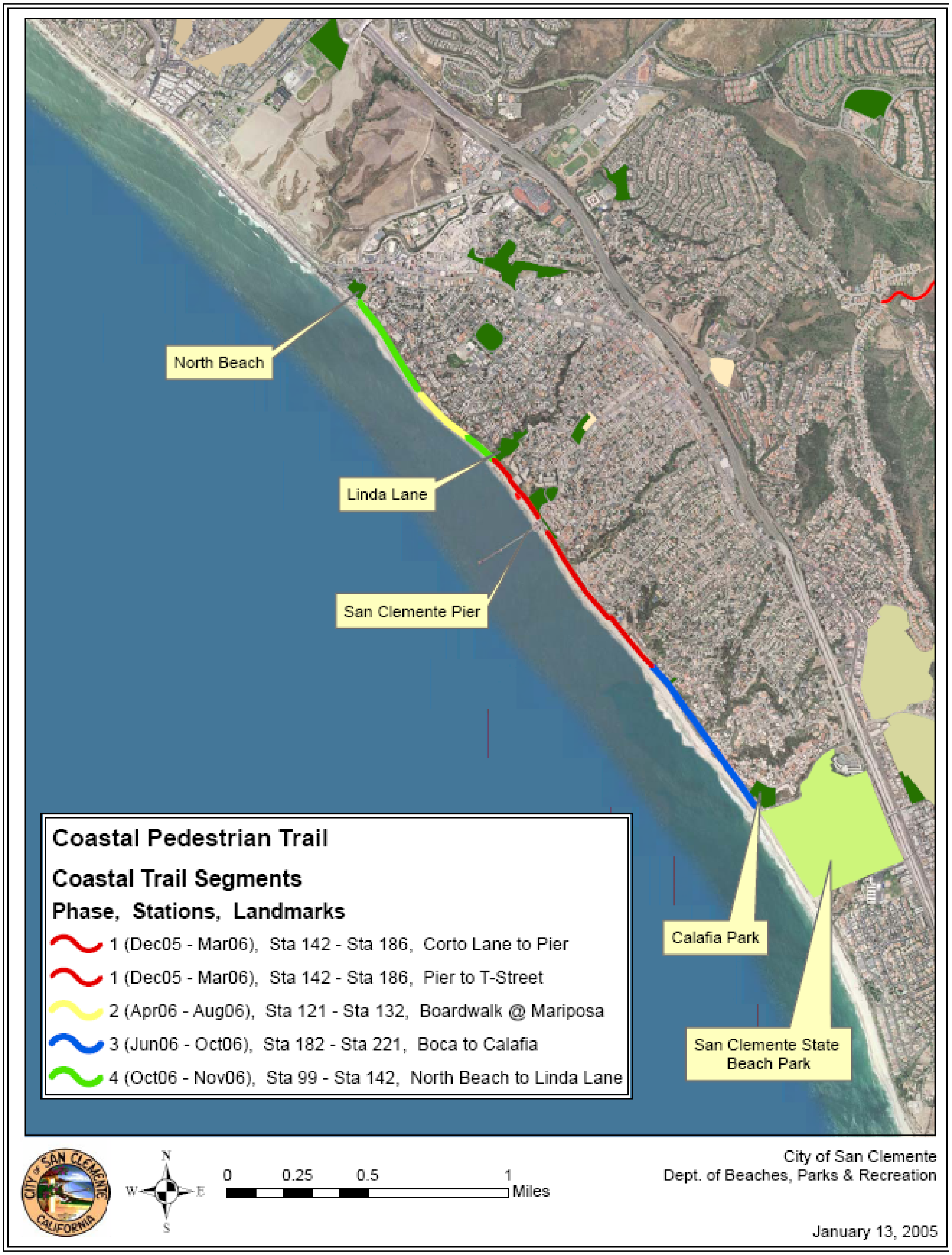


Figure 2-16 San Clemente Beach Trail

2.9.8 Recreational Activity

San Clemente is one of the most popular recreational areas for surfing. The City is the headquarters of the Surfrider Foundation, claiming 29 chapters nationwide and a membership of 25,000. There are eleven thriving surf shops and over a dozen major surf industry manufacturers, five of the world's most prestigious surf publications, as well as five surf schools and camps in the City. The San Onofre Surf Club is the oldest and largest in the world. San Clemente surfers have won championships in every competitive circuit and nearly every category in the United States. The popularity of surfing is related to some of the most outstanding wave conditions on a consistent basis, which include the areas from the "204" and the Pier, to T-Street, Riveria and State Park. In addition, the back area is heavily used for sun bathing, picnicking, swimming and beach-related sports.

The City of San Clemente beaches and Pier provide a major focal point for the community and community activities. In addition to its usual popularity for recreation use, it provides the venue for two of the City's highly popular annual weekend events including the Ocean Festival and the Sea Fest. These yearly events attract tens of thousands of visitors to the area providing numerous family activities, cook-offs, and arts and craft shows.

2.9.9 Attendance

Figure 2-17 and **Table 2-18** show annual attendance at San Clemente's beaches in terms of beach days. From 2000 through 2006, visitations at San Clemente's City and State beaches averaged 2.22 million, with the City beach accounting for 89% of all visits. During this period, overall beach attendance in San Clemente grew, on average, by 3.9% per year. State beach attendance showed no discernable growth between 2000 and 2006. We note that the relatively large variations in attendance at the State Beach since 1998 have been accompanied by opposite variations in attendance at the City Beach. One explanation is that a significant portion of these variations may be the result of attendance shifting from one beach to the other.

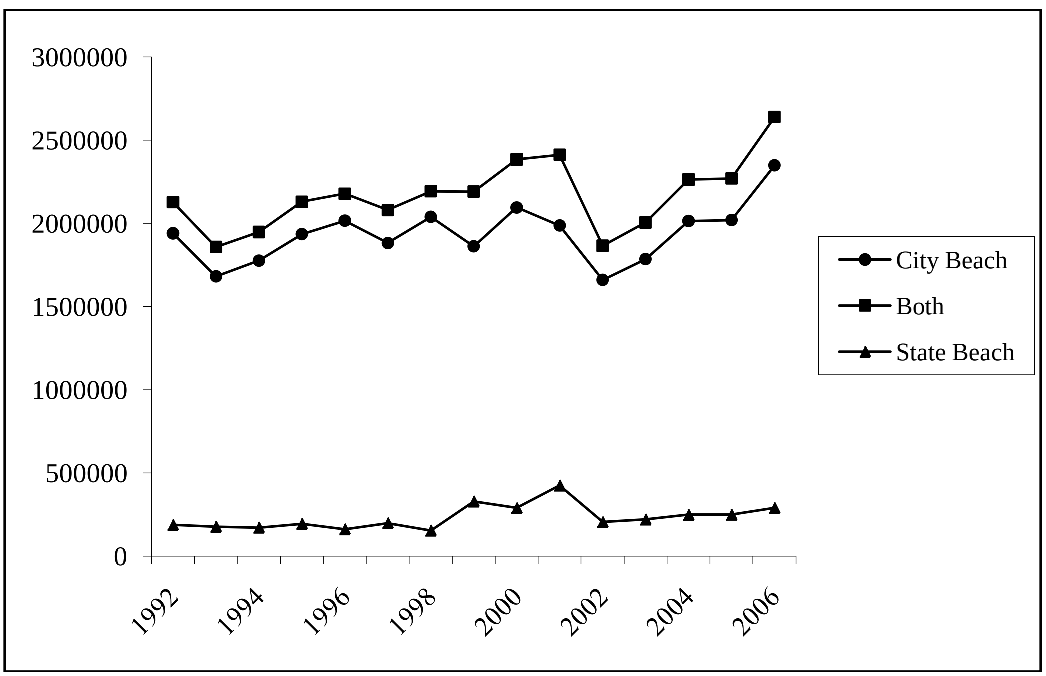


Figure 2-17 San Clemente Beach Attendance

Table 2-18 Beach Attendance for Both City and State Beaches

Year	Attendance
1960	233,000
1970	2,057,000
1980	1,480,000
1990	2,068,000
1991	1,835,000
1992	1,940,000
1993	1,614,000
1994	1,776,000
1995	1,935,000
1996	2,016,000
1997	1,812,000
1998	2,039,000
1999	1,626,000
2000	2,096,000
2001	1,987,000
2002	1,865,000
2003	2,006,000
2004	2,264,000
2005	2,670,000
2006	2,639,000

2.9.10 Future Beach Use

Over the past ten years, attendance at San Clemente's beaches has grown by roughly 2.7% a year, while the rate of population growth in Orange County has been 1.5%. Although the rate of growth in beach attendance has exceeded that of population, it is assumed for this study that the future rate of growth of beach attendance will mirror that of population growth. **Table 2-19** summarizes our estimates of population growth for Orange County and the corresponding increase in attendance. Population estimates to 2050 are taken from the State of California's Department of Finance's Demography Department estimate for 2007.

Table 2-19 Projected Beach Attendance

Year	Orange County Population	Avg Yearly % Growth Rate	Total Beach Attendance
2000	2,863,834		2,095,650
2010	3,227,836	1.20%	2,768,827
2020	3,520,265	0.87%	3,019,668
2030	3,705,322	0.51%	3,178,423
2040	3,849,650	0.38%	3,302,244
2050	3,987,625	0.35%	3,420,614

3 STATEMENT OF PROBLEMS AND NEEDS

3.1 Statement of the Problem

Prior to the 1990's, the beaches within the study area were marginally-stable as sufficient sediment was supplied from San Juan Creek to the Oceanside littoral cell. This was prior to upland urban development that deprived the sand supply causing the system to become "sand starved". Since the 1990's, the beaches in the study area have experienced gradual erosion due to the decrease of fluvial sand supply resulting from the damming and concreting of creeks and rivers, and urban development. As a result, the beaches provide minimal protection against storm-induced damages to the railroad and public facilities. The documented historical beach width above the Mean Sea Level (MSL) line between T Street and Mariposa Point was as narrow as 25 meters (82 ft) in the winter months (USACE-SPL, 1991). As a consequence, storm damages occurred in the past (e.g. 1964, 1983, 1988 and 1993), as the protective buffer beach width was narrow, particularly in the winter season.

The narrowing of the beaches along the shoreline has subjected the public facilities to wave-induced damages. These facilities include the Marine Safety Building, public restrooms, lifeguard stations, parking areas, and concession stands. Information from the Economics Appendix is given in **Table 3-1** and shows the historical damages to public facilities along the shoreline. The meteorological conditions of El Nino occurred in the years 1983, 1988, and 1998. The majority of repairs in the years of 1983 and 1988 were due to damages to the San Clemente Pier. The City spent $2,109,000 in Pier repairs in 1983 and $2,305,000 in 1988. Also, repair costs for a revetment in the community of Capistrano Shores totaled $288,000. In addition, the City is spending $5,000 per year to use a tractor to reduce the steepness of the shoreline.

PROBLEM STATEMENT: Along the shoreline of San Clemente, a lack of sediment supply to the shoreline has resulted in chronic, mild, long-term erosion. The LOSSAN railroad corridor is a vital link for passenger and freight service and has been designated as a Strategic Rail Corridor by the Department of Defense. As the protective beach lessens over time and is eventually lost, it is expected that storm waves will act directly upon the railroad ballast, significantly threatening the operation of the LOSSAN railroad line. The narrowing beaches are also expected to subject ancillary beachfront public facilities to storm wave-induced damages, and further reduce recreational space on an already space-limited beach.

Table 3-1 Historical Damages Recreational Facilities (October 2010 price level)

Year	Reason for Expenditure	Amount	Comments
1983	Facility Protection/Storm Damage Repair	$3,277,000	El Nino Storms
1988	Facility Protection/Storm Damage Repair	$3,120,000	El Nino Storms
1994	Storm Damage	$21,600	
1995	Storm Damage Repairs	$7,200	General Repairs
1996	Storm Damage Repairs	$16,500	General Repairs
1997	Facility Protection/Storm Damage Repair	$54,000	Repair of Marine Safety Sheet Pile
1998	Storm Damage Repairs	$376,000	General Repairs
1999	Storm Damage Repairs	$52,000	General Repairs
2000	Storm Damage Repairs	$14,400	General Repairs
2001	Storm Damage Repairs	$63,000	General Repairs
2003	Facility Protection	$202,000	Repair of Marine Safety Sheet Pile

3.1.1 Impacts to Railroad Service

The LOSSAN railroad line is constructed on conventional elevated crushed rock ballast along the base of the entire study area's coastal bluff. The railroad line is a prominent feature that completely separates the active coastline from the coastal bluff and adjacent backshore development. The LOSSAN railroad line is a vital transportation link for passenger and freight service. In addition, the Department of Defense has designated this right-of-way as a Strategic Rail Corridor with great significance to National defense. Railway traffic service delays occur when storm wave run ups exceed the elevation of SCRRA protective revetments or the crest of the railroad ballast in the segments without a revetment.

As documented by the SCRRA, railway traffic service delays have occurred when waves overtopped the structures during severe storms in the past. Two service disruption incidents of approximately 24 hours occurred in the 1960's at Mariposa Point (north of the Pier) and in the 1970's (McGinley, 2003) at a location south of the Pier. The failure was due to wave backwash upon overtopping the railroad ballast that eroded the embankment.

Due to chronic beach erosion in recent years that resulted in storm wave attack directly against the railroad corridor, the SCRRA and OCTA have constructed un-engineered riprap revetment segment by segment in the San Clemente area where the railroad ballast and tracks are vulnerable to storm wave-induced damages. The revetment placement practice consists of 1) delivering rocks to the roadbed via railroad cars; 2) positioning the rocks into a uniform row alongside the roadbed with a safe distance from the tracks by tracker excavators and rubber tired end loaders; and 3) side-dumping the sloped embankment. The front-face slope of the revetment ranges between 1:1 and 1.5:1 (horizontal: vertical) downward to the beach. The crest of the revetment structure is approximately one meter above the railroad ballast to reduce wave overtopping. The riprap placement is primarily confined within the 6 to 9 meters (20-30 ft) west of the centerline of the railroad tracks.

The SCRRA has been side-dumping riprap stones in a random but controlled manner along the most critical segment between North Beach and the Marine Safety Building to mitigate wave-induced impacts on the railroad tracks. The maintenance practice of adding additional stones to the existing under-designed revetment has cost the SCRRA an average of $300,000 over every three-year period. The cumulative impact of stone placement over the years has been a curtailment of lateral beach access. Over the past ten years, storm wave attack in the study area has restricted train services periodically. During the 1998 El Nino, the protective revetment structure sustained severe damage that slowed down the train movement to ensure safe passage in the San Clemente area.

With the continuous shoreline retreat as anticipated, the potential of direct damage to the railroad ballast and tracks becomes highly probable, as the frequency of storm waves directly impinging upon the railroad ballast increases. The significance of transportation impacts, if the tracks are damaged by storm waves, would be similar to the prolonged service disruption resulting from the 1993 major mudslide in San Clemente. The railroad service was interrupted for 5 days during which more congestion occurred on Interstate 5, due to additional passenger vehicles and trucks. Furthermore, there exists no other economical means to deliver some commodities, such as liquefied natural gas, to the location across the border (e.g. Tijuana) for the essential use. Businesses receiving freight service incur higher costs to transport goods (e.g. grain, lumber, etc) that cannot be shipped by rail.

The cost to protect the tracks with additional side-dumped riprap stones will increase accordingly. Furthermore, crews will frequently be dispatched during high tide and storm conditions to visually inspect for track damage that can cause derailments. Thus, continued beach erosion along the San Clemente shoreline will lead to further disruption of rail service.

SCCRA is in the process of modifying the existing maintenance practices in response to evolving California Coastal Commission policies. In order to avoid and minimize any possible service disruption, it may become necessary or mandatory for the SCRRA to construct an "*engineered*" seawall. A conceptual seawall design and cost estimate was prepared by the City of San Clemente (Moffatt & Nichol, 2007).

In May 2003, the California Coastal Commission (CCC) proposed changes to the current maintenance plan. The CCC has significant concerns regarding the impacts of the current maintenance plan in regards to natural sand supply and recreational resources. In order for the SCRRA to get a permanent permit for the existing revetment, the SCRRA must convince the CCC that the revised maintenance plan addresses these impacts. Currently, Metrolink is committed to maintaining existing revetment areas based on the terms provided in the California Coastal Commission Consistency Certification dated May 23, 2003 (CC-033-03). The Certification identifies a "limit line" defined as the line where the rock meets the sand. This limit line establishes the revetment slope of 1H:1V. Metrolink has committed to not construct or place additional riprap to flatten the slope of the existing revetment seaward of this line. To ensure the slope of the existing revetment remains unchanged, Metrolink intends to maintain this revetment through the strategic placement or "keying in" of rock. The permit for the maintenance plan pertains to the sections of the railroad that are protected by a revetment. Reach 6, our project area, does not have a revetment currently in place, therefore, the option of "keying in" of rock is not considered. Another alternative for this reach is described below.

Recent discussions among the local stakeholders have indicated that the construction of a seawall is the likely alternative as it provides adequate protection to the rail corridor, minimizes impacts to the remaining beach, and provides safer public access by allowing for organized crossings. Through these discussions with the railroad and the City and the examination of the physical data, a significant concern of the protective effectiveness of the beach develops around a 3 meters (10 ft) width dimension. Under “average” long-term erosion conditions as stated in Appendix D of the EIS/EIR (mean historic erosion rate = 0.1 m/yr (0.33 ft/yr)), a 3 meter (10 ft) beach width would require 30 years before being completely eroded away– leaving only the small railroad shoulder buffer between the tracks and ocean. However, if storm induced erosion is entered into the equation, the potential for damage increases dramatically. There is a 1% chance that storm induced erosion will be 8 m (26 ft), which means that a 3 meter (10 ft) beach would erode completely during a 1% event, potentially endangering the railroad.

The process for implementing protective measures beyond those covered by the California Coastal Commission’s Certification would be time consuming – several years at the minimum. It is economically unreasonable that railway parties would wait until an imminent danger existed, given the strategic nature of the LOSSAN corridor. Additionally, the City Manager of the City of San Clemente has declared the City support for the construction of a seawall, and to successfully navigate the current regulatory process to protect the rail corridor along the San Clemente shoreline, OCTA and Metrolink would tend to pursue the construction of seawalls, with various funding partners, in lieu of revetments as the need arises. For these reasons, the study has adopted a 8 meter (26 ft) beach width criterion for the point at which the SCRRA would construct a seawall to protect the railroad. This 8-meter (26-ft) criterion has been adopted in that it coincides with the 1% chance of storm erosion potential and conforms to the typical FEMA goal of urban flood protection for insurance removal.

The long-term comprehensive solution of seawall construction is dependent upon shoreline placement entering the 8 meter (26 ft) zone. Within a given reach, the model’s triggering mechanism for seawall construction requires between 300 and 500 meters (984 to 1640 ft) of shoreline to be within the 8 meter (26 ft) criterion. However, this seawall construction does not eliminate the potential for storm induced damage prior to its construction. Emergency storm related damages to the existing revetment as well as the areas protected only by the ballast (such as Reach 6) will remain a possibility until the long-term seawall solution is in place. It is probable that an emergency repair may be applied to the damaged cell prior to the comprehensive upgrade or construction of a newly designed seawall during a severe storm event.

Therefore, the railroad is assumed to be permanent and always exist throughout the period of analysis, acting as a protective structure and fixing the position of the shoreline. As such, the railroad is considered the landward boundary and no storm damages are considered landward of the railroad.

3.1.2 Recreational Impacts

The San Clemente Beaches are a major popular recreation venue for the region as is evident by the overcrowded attendance during peak use days. The continuing erosion of the beaches will further reduce the already limited recreational spaces on the beaches. As a consequence, the beach goers will eventually seek alternative beaches for recreational activity on other adjacent beaches in Orange County.

Furthermore, continued damages to the public facilities resulting from the shoreline retreat may require their relocation to the landward side (east) of the railroad tracks. This will require pedestrians to continually cross the tracks to use the restrooms and results in a public safety concern since many will cross the railroad tracks in an unsafe manner. Additionally, the loss of sand within the active nearshore profile has exposed underlying hard substrate and man-made structures. These man-made structures consist primarily of protective measures constructed to protect the base of the Marine Safety Building and the public restrooms. A public safety issue is created because the exposed substrate and protective structures, in many cases, remain underwater and hidden from sight posing a number of potential dangers to unwary recreational swimmers. Thus, continued shoreline erosion will be detrimental to the beach recreation, resultant tourism, and economic benefits in San Clemente that has an annual tourist visitation of some two million people, approximately 60% non-residents.

3.1.3 Public Facility Damages

Public beach facilities located in Reach 6 include the Marine Safety Building, public restroom facilities located on the back beach, lifeguard stations, parking areas, and paving near the Pier. The beach facilities provide basic services and enhance the recreational experience for users at the City's beaches and have experienced storm damage in the past, as historically the beach width that acts as a buffer against storm wave attack has been narrow to moderate. The 1983 El Nino storm season has resulted in an estimated damage of $3,277,000 to coastal dwellings located landward of the railroad track and public beach facilities in the San Clemente area.

As the beach buffer that provides storm protection is further narrowed, frequent storm damages are expected to occur. Recently, an emergent sheet pile had to be installed seaward of the building to prevent the undermining of the Marine Safety Building. A similar condition that required the installation of an emergency sheet pile also occurred at a restroom located in Reach 6. In order to quantify the amount of erosion that the beach may experience in the future, a coastal storm damage model was developed.

3.2 Risk and Uncertainty Model

The model developed for the San Clemente Shoreline Study uses the principles of Risk & Uncertainty (R/U) in compliance with U.S. Army Corps of Engineers policy that requires all new federally funded coastal studies to incorporate the principles of R/U. The principal controlling guidance of the analysis comes from the U. S. Army Corps of Engineer's *"Planning Guidance Notebook"* – ER 1105-2-100, with specific guidance from Appendix D – Economic and Social Considerations and EM 1110-2-1100 – *"Planning and Design Process."* Additional guidance on the risk-based analyses has been obtained from EM 1110-2-1619, dated 1 August 1996, *"Engineering and Design - Risk-based Analysis for Flood Damage Reduction Studies."* The application of R/U in this study not only covers traditional elements of damages and coastal processes, but also covers construction costs.

3.2.1 Risk and Uncertainty Analysis

At the time of the initiation of this study there was not a Corps of Engineers standard model for R/U analysis for coastal zone storm damage reduction studies. A nationwide model for coastal zone R/U analysis is currently under development by the Corps of Engineers, however, the model completion schedule did not allow for utilization for this study. Fifty-eight models were evaluated for implementation under this study and included the Generalized Risk and Uncertainty Coastal model (GRANDUC) developed by the Wilmington District and the Risk

Storm Damage Model developed by the Jacksonville District. These R/U models, which were developed independently at different times by the respective districts, were evaluated extensively. Due to a variety of engineering considerations, technical, programming language, and other reasons, each model was not selected for use for this study. An interim model was developed that is uniquely applicable to the physics and storm conditions that are experienced within the Los Angeles District. This model utilizes many of the concepts and to a large degree is consistent with the certified nationwide model (Beach-fx).

The model used in the present study is an integrated coastal engineering – economics analytical framework for evaluating the physical performance and economic costs of shore protection projects, particularly, beach nourishment along sandy shores. The model has been implemented as an event based Monte Carlo life cycle simulation tool that is run on desktop computers. This model initiates with coastal engineering data and input, performs a series of engineering and economic computations, and concludes with economic outputs. The model inputs consist of probability distributions for various coastal engineering parameters. The model outputs consist of histograms of individual damage categories. The model does not compute annual net benefits and/or benefit/cost ratios.

The principles of Monte Carlo Simulation are used as the numerical integration technique. The proprietary computer program @RISK (Palisade, 2002) was used to run the R/U analysis. @RISK is an add-in to a standard industry spreadsheet package that provides the necessary tools for executing a Monte Carlo Simulation.

This model incorporates R/U by utilizing probability distributions for variables and design parameters where appropriate. It is recognized that the "true" values of the design variables and parameters are frequently not known with certainty and can take a range of values. However, the likelihood of a parameter taking on a particular value by a probability distribution can be described. The probability distribution may be described by its own parameters such as mean, standard deviation, shape, and scale. In some cases, the probability distribution for a parameter may be well established in the engineering literature, or in other cases a best-fit distribution of the measured data may be applied.

Procedurally, the without project damage assessment was conducted by employing a life-cycle approach. As outlined in EM 1110-2-1100, the life cycle approach deals with multiple realizations of possible evolution of the project with time during the span of its design life. The suite of life cycle realizations is constructed with consideration of the probabilities of key variables. The life cycle approach appears better suited to most coastal engineering applications. Variation with time is an essential ingredient in most coastal projects, and it is directly incorporated into the life cycle approach. Time variation of resistance and functional performance, constraints imposed by construction season and mobilization, even some economic and environmental factors, can be conveniently and flexibly introduced into the life cycle approach. This approach leads to a unified analysis of technical performance and many economic factors which are critical to project success.

The life-cycle model randomly samples various input probability distributions, calculates various coastal engineering parameters, and quantifies the individual damage mechanisms. The life cycle embodies sequences of storms (including provisions for multiple storms of varying intensity during each year of the life cycle), erosion and post-storm recovery during each event, partial and complete property damage during each event (depending on water level, waves, extent of storm erosion, and type of building construction), cumulative property damage due to a succession of storms, optional repair or rebuilding after a suitable time lag (with conformance to any stricter building codes in effect), and periodic renourishment of the beach when needed and feasible during the life cycle. The model transitions to various economic calculations, and quantifies the damages due to the individual damage mechanisms. Typically, a key result from this analysis is the renourishment required during each life cycle, which can be converted to an economic present-worth dollar value. The expected cost and economic risks associated with maintaining the beach can then be realistically assessed by combining information from many different life cycle simulations. Specific considerations of the model include:

Seasonality

This model is a single season model; seasonality of the wave climate is not considered. It is generally accepted that the most damaging storms in southern California occur during the winter months. Although it is recognized that very large wave events can and do occur during the summer season, the winter extra tropical storms tend to cause the majority of the property losses.

Single Storm

This model is a single storm event model; multiple storms are not considered. It is recognized that several "storms" occur every winter season. In fact, it is generally accepted that storm "clusters" are responsible for some of the most damaging storm years in southern California. This was clearly observed in the 1982-1983 storm season when a series of six independent storm systems caused widespread coastal damages in southern California

A single annualized storm is believed to fairly represent the majority of the shoreline change and economic losses. It is well established that shoreline changes and the resultant economic damages tend to be cumulative throughout the storm season. However, there is little or no data that allows the full and quantitative delineation of the shoreline changes and economic damages attributed to individual storms in a cluster of successive storms. Shoreline change monitoring and measurement efforts typically are conducted on a time basis that is not in direct response to storm damages. In general it is typical that detailed descriptions of economic damages are recorded and compiled well after the storm season has ended. Therefore, there is no reliable method to individually distribute and compartmentalize the combined shoreline changes and economic damages that do occur to a sequence of storms. Each of the iterations of the Monte Carlo simulation randomly selects a storm event where the significant wave height equal or exceeds the mean annual significant wave height. Based on the annual maximum wave heights for the measured data record, the mean annual significant wave height is 2.60 m (8.5 ft). This value is consistent with conventional coastal engineering practice for expected annual maximums within the Los Angeles District.

Reach Subdivision – Cells

The study area was initially divided into 10 reaches of various lengths based upon the presence or absence of armor stone protection along the railroad. In order to provide a finer subdivision for detailed analysis of model performance and interpretation of the results, Reaches 1-9 were further subdivided into 50-meter (164 ft) segments.

Independent Sediment Transport Processes

It is convenient to separate nearshore sediment movement into two components, longshore sediment transport and cross-shore sediment transport. These two transport mechanisms were assumed to be separate and independent in this study. This separation is not always valid in a strict sense because it is implicitly based on the assumption of plane and parallel profile contours. The time scale associated with storm-induced beach erosion is on the order of 1-3 days and depends on the level and duration of the wave and tide characteristics, whereas the time scale of beach adjustment is several months to years. Independence of cross-shore and longshore sediment transport relieves the responsibility of rigorously describing the joint morphological processes that occur. Independence of cross-shore and longshore sediment transport processes results in substantial improvement in numerical computational efficiency.

Numerical Simulation Concepts

The model employed in the present study is a spreadsheet-based model in which the Monte Carlo simulation is conducted by a spreadsheet add-in package. Use of the spreadsheet allowed each year of the economic life-cycle to be represented by one column of the spreadsheet. Thus, the spreadsheet nature of the model eliminated the numerical requirement to iterate for each life-cycle year. Each iteration represents a new simulation that results in substantial numerical computational efficiency. A single annualized storm event provides substantial numerical simplicity over the numerical complexity inherent in a time-dependent simulation. A single storm each year of the life-cycle relieves the responsibility of rigorously describing the coastal and morphological processes that occur during a time dependent sequence of storms. This results in substantial improvement in numerical computational efficiency. Simulation outputs were monitored for numerical convergence to evaluate the stability of output distributions during a simulation. A convergence criterion of 1.5% was established for convergence statistics for each output distribution. Model execution is continued until all pertinent economic outputs achieve the convergence criterion. Model convergence was typically achieved in less than 1000 simulations.

Railroad Reach Conversion Criteria

As discussed in Section 3.2, Metrolink is committed to maintaining existing revetment areas based on the terms provided in the California Coastal Commission Consistency Certification dated May 23, 2003 (CC-033-03). At a certain point in time, SCRRA will be forced to construct a seawall to protect the railroad rather than continuing to maintain the existing revetment and ballast in areas without a revetment (such as Reach 6). The point at which the SCRRA would construct a seawall is called the railroad reach conversion criteria. This criteria is comprised of two parts: a minimum beach criterion and a seawall conversion criterion. The minimum beach and seawall conversion criteria work jointly together and estimate when an unimproved (ballast) railroad reach will be improved by construction of an engineered seawall. The minimum beach criterion developed by coastal engineering is fixed at 8 m (26 ft) and is derived from the estimation of the 1% chance of for storm induced erosion. The seawall conversion criterion used in the present study is a uniform distribution ranging from 29% - 48% (6-10 cells); the criterion is randomly selected during the Monte Carlo simulation.

It is expected that the SCRRA will not have the funds immediately available to construct a capital improvement project. SCRRA is expected to navigate a budget process where funds are authorized and appropriated before plans and specifications and construction occur. This results in an inherent delay between the capital improvement decision and the actual implementation (construction) of a project. The seawall conversion criterion attempts to model this behavior. The seawall conversion criterion is a time-delay criterion and has the effect of accelerating or delaying the decision-making process for implementation of a capital improvement project. The seawall conversion criterion ranges between 0-100 percent. Since, it is likely that SCRRA cannot invest in a capital improvement project immediately, i.e. 0%. It is expected the SCRRA will not wait until the entire existing beach is completely eroded, i.e. 100%. The 29% - 48% is an estimate for seawall conversion that encompasses these considerations. Currently 24% of the cells in Reach 6 have beach widths less than 8 m (26 ft).

During the Monte Carlo life-cycle simulation the model tracks the protective beach width in each cell of unimproved reach which currently are Reaches 2, 4, 6, and 8. Reach 6 is the only one under consideration for this study analysis. When the protective beach width is equal or less than 8 m (26 ft) the model flags this cell. The percentage of flagged cells is computed by the running total number of flagged cells in the reach compared to the total number of cells in the reach. When the flagged percentage equals or exceeds the randomly selected seawall conversion criterion, the model assumes that a seawall is constructed in the reach.

LOSSAN Service Delay

Railway traffic service delays result when severe wave run-up and overtopping exceeds the elevation of SCRRA protective revetments sufficient to interrupt service. There is no generally accepted guidance or methodology formulated to define the overtopping criteria necessary to interrupt railway service. Therefore, rail traffic service delay was directly related to revetment failure. If run-up and overtopping conditions are severe enough to cause revetment failure, then the railway traffic would logically be interrupted while the revetment and railway is repaired. Criteria have been established to compute railway traffic service delay that combines run-up elevation and a probability of occurrence. Run-up elevation must equal or exceed the revetment elevation. Since the actual rail line is constructed at or below the revetment crest elevation, overtopping of the revetment crest will logically result in overtopping of the railroad. When overtopping exceeds the revetment crest elevation, thereafter there is a 50-50 probability that this overtopping condition will result in revetment failure. The rail traffic service delay criteria are calibrated based on the total number of delays experienced during a simulation. Based on the damage description provided by the SCRRA, there were two service delays in the 1960's and 1970's. It is estimated that this time period extends to the 1950's if not earlier, which is approximately 50 years. Thus, on average the model should predict approximately 1-2 service delays in each 50-year simulation.

Revetment failure and the subsequent railway traffic service delay are treated equally and independently for each reach and each cell. Revetment failure is allowed only if the entire reach has not been converted to a seawall. A seawall is considered to permanently protect the railroad and no failure is allowed. The rail traffic service delay costs are divided into separate components consisting of costs to repair the railroad and losses to service interruption. Due to the nature of the model, it is possible that multiple railroad cells are damaged at the same time, but only one service delay is counted. Information provided by the SCRRA indicates that a 50 meter (164 ft) long railroad cell could be repaired on the order of hours after incipient damage; therefore multiple cell segments failing at the same time will not have a substantial multiplying effect to the service delay.

Structure Damages

All public buildings are located in Reach 6 of the study area, with the exception of one facility in Reach 8. These buildings provide basic services that enhance the recreation experience for users at San Clemente Beach. Building costs for these structures are significantly higher than inland, due to costs of protection (sheet pile and caissons) and the building materials necessary for an ocean environment. Estimates of depreciated replacement value for the structures are based on data from Marshall & Swift and construction information provided by the City. Content values are based on information provided by the City. The replacement cost of the Pier was excluded from the analysis since the Pier is not susceptible to damage from the erosion of the shoreline.

The San Clemente Pedestrian Beach Trail, shown in **Figure 3-1**, is a multi-use pedestrian beach trail that has been recently completed at a cost of $11.8 million. The 4 km (2.5 mi) trail spans from North Beach to Calafia. It is located at the base of coastal bluffs and the beach within the right of way of the existing rail corridor. The trail consists of a 1.5 to 3 meter-wide (5-10 ft) at-grade multi-use path, approximately 260 meter (850 ft) long, 2.4 meter (8 ft) wide elevated walkway "at pitch point" at Mariposa Point, three short bridges to cross drainage channels at Trafalgar, Riviera and Montalvo, improvements to existing El Portal, Montalvo and Mariposa for pedestrian under rail crossings and pedestrian at grade crossings at Dije, El Portal, Corto Lane, "T" Street South and Lost Winds for beach access. The trail is constructed of natural materials, including stabilized decomposed granite, class II base and filter fabric. Barriers consisting of landscaping, rocks and fences are installed between the rail and trail. This new pedestrian trail addresses existing safety and adequacy issues with existing opportunities for public access to and along the coast in San Clemente. Overall safety has improved for pedestrians who cross the train tracks to access the beach in south San Clemente. The San Clemente Pedestrian Beach Trail also serves to form a significant link in the statewide Coastal Trail, making more of the beach accessible to the public by creating a coordinated access system of regional and statewide significance. In Reach 6, the trail is on the shore of the railroad tracks and will be subject to erosion and wave damage.

The model considers the trail as dry land that is eroded by long-term erosion or storm induced erosion. When this land is eroded, the associated portion of the trail is considered lost. The costs of the rock roadway portion of the trail are accumulated. The major trail damages are the future costs incurred for relocation and replacement of the trail to the landward side of the railroad.

Figure 3-1 San Clemente Beach Trail

Recreational Beach

Long-term erosion and the landward advancing shoreline reduce the beach surface area available for recreation. The model simulation randomly selects a long-term erosion value and computes the dry beach area (aggregate of cell length x width) each year throughout the 50-year life-cycle. A time series plot of a 50-year life-cycle indicates a continually declining amount of dry beach area. A full description of the recreation analysis is found in the Economics Appendix.

3.2.2 Without Project Model Results

The R/U model (**Table 3-2**) for San Clemente was run for 1000 simulations under the without project conditions. Each simulation generates an individual forecast of annual erosions and storms for the 50-year period of analysis. Some of the key inputs to the model are as follows:

1 Long-term annual erosion: Defined in the model as a triangular distribution of Risktriang (-0.46 m, -0.21 m, 0.37 m) (-1.5 ft, -0.7 ft, 1.2 ft) with a mean annual value of -0.1 m (-0.33 ft). Storm erosion, wave height, sea level rise, and run-up (see Appendix D of the EIS/EIR).
2 Seawall construction trigger mechanism: Seawall construction is implemented if the number of beach cell having beach widths less than 8 m (26 ft) exceeds the random criterion of RiskDuniform ({6, 7, 8, 9, 10}) – 6 to 10 cells corresponding to 300 to 500 meters or between 28.6 to 47.6 percent of the entire reach. The justification for the range of values used for the seawall conversion criteria of 6-10 cells was based more on a qualitative rather than a quantitative analysis. This range of cells corresponds with a range of widths of 300 to 500 meters (984 to 1,640 feet). It was determined that this range was logical because a narrower criteria would show that the seawall would be built within the next couple of years, but the expected timeline to construct a seawall is expected to be four or five years. Therefore, narrower criteria did not seem reasonable to describe the expected response by SCRRA. A larger range for the criteria is expected to cause portions of the rail road track to become too vulnerable to future storm events. Further, it was felt that by applying a range rather than a single number of cells for the criterion addressed the issue of uncertainty.
3 Depreciated structural values based on City construction data and Marshall & Swift without uncertainty (Table 5 Economics Appendix) with first floor elevations (FFE) based on field survey data. FFE is generally at beach level, a zero elevation, with the notable exception of the marine headquarter building at 1 foot above beach level.
4 San Clemente Pedestrian Beach Trail – a Reach 6 DRV of between $2.8 and $3.24 million.
5 The Houma structure & content and District's wave force functions are employed.[2]
6 Transportation damages as outlined by Table 12 of the Economics Appendix.
7 The LOSSAN construction and O&M costs shown in Table 13 of the Economics Appendix.
8 The recreation value as indicated by Table 27 of the Economics Appendix.

[2] These functions are displayed in Attachment A.

9 Interest During Construction (IDC) is calculated using a mid-term full expenditure pattern approach. With a short construction timeframe of 3 to 6 months for any alternative IDC is not a major cost component.

Table 3-2 Without Project Model Results – Reach 6
FY11 Prices & Discount Rate

	Minimum	Maximum	Mean	5% Probability Value	95% Probability Value
Seawall Construction Year	2009	2058	2021	2011	2036
# of RR Breaches	0	4	0.014	0	0
Damages & Costs:					
RR Construction & O&M Costs - Average Annual (AA)	$220,136	$2,342,507	$1,275,274	$329,605	$1,996,263
Trail Damage - AA	$0	$132,781	$81,821	$0	$121,808
Structure & Content Damage - AA	$3,179	$123,382	$62,923	$26,362	$93,915
RR Delay Costs - AA	$0	$0	$0	$0	$0
Total Damages - AA	$288,514	$2,555,729	$1,420,018	$392,701	$2,181,170
Recreation:					
Reach 6 AA of Recreation	$9,666,171	$11,539,598	$10,667,923	$10,157,058	$11,196,251
AA UDV Reach 6	4.67	5.85	5.24	4.94	5.56
Weekend Sqft - Summer	30	30	30	30	30

The model predicts Reach 6 beach erosion will require the construction of the seawall in 2021, on average. There is a 5% chance that seawall construction will be required before 2011 and a 5% chance that the construction will occur after 2036. Breaching of the LOSSAN corridor appears unlikely – 0.014 times on average during the study period; and as a result delay times are $0. The model also indicates that the summertime weekend beach use will be at maximum capacity (30 ft^2 per user) throughout the study period.

The majority of NED damages/costs are related to LOSSAN construction and O&M costs. This result is as expected with erosion requiring the construction of the seawall. The mean average annual cost to LOSSAN is $1,275,274. The mean annualized value of all damage is $1,420,018.

The model predicts maximum capacity at summertime weekend use; however, the average UDV value (annual value/total annual users) of $5.24 corresponds to an average allotment of 65 ft^2 per user. The mean annualized value of recreation in Reach 6 is $10,667,923.

4 PLAN FORMULATION

4.1 Planning Process, Planning Opportunities, and Alternative Formulation.

Plan Formulation can be broken down into a six step process:

1. Identify Problems and Needs
2. Inventory and Forecast Conditions
3. Formulate Alternative Plans
4. Evaluate Alternative Plans
5. Compare Alternative Plans
6. Select a Recommended Plan

This process is a structured approach to problem solving which provides a rational framework for sound decision making. The six-step process is used for all planning studies conducted by the Corps of Engineers. The planning process is iterative by nature, with a given study performing the steps multiple times until a decision is reached. The steps give a sense of order to the planning process, but the process really is focused on balance and not rigid at all. For any given study, a number of iterations are usually required. Iterations can start with any step. Each step is performed at least once, but not necessarily in the listed order. Evaluation of environmental conditions and effects of alternative actions follows a parallel process considers a broad range of alternatives, narrows that range to a set of alternatives considered in detail, and then compares the environmental effects of each alternative considered in detail.

The sections below first provide an introduction to plan formulation objectives, constraints, and preliminary alternatives and measures considered. These measures are then screened and developed into project alternatives for full analysis. A recommended plan is finally identified which best meets the stated objectives and constraints.

4.2 National Objective

Federal and Federally-assisted water and related planning activities attempt to achieve increases in National Economic Development (NED), while preserving environmental resources consistent with established laws and policies. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. The NED objective is differentiated from Regional Economic Development (RED) benefits, which only apply to a given region, often at the expense of another region in the U.S. NED benefits accrue nationally for a net gain in Gross Domestic Product. They represent return on the investment of Federal funds, and are a useful tool in comparing the efficiency and effectiveness of alternative projects on a nationwide basis. Plans are formulated to take advantage of opportunities in ways that contribute to the NED objective. In accordance with ER 1105-2-100, it is Corps policy to provide Federal assistance in the prevention or reduction of damages caused by wind and tidal generated waves and currents along the Nation’s shoreline.

The standard period of analysis is based on a 50 year functional project life. Damages (which may be financial costs or actual structural/infrastructure damages) and lost opportunities (recreational, etc.) are projected for the future without project and for the future with an array of different alternatives. The benefits of each alternative are expressed in dollar amounts of damages prevented and opportunities preserved or created.

4.3 Public Opinion

A number of public concerns have been identified during the course of the study. Input was received through coordination with the sponsor, coordination with other agencies and through a public workshop held in January 2002. A discussion of public involvement is included in Chapter 8, Public Involvement, Review and Consultation. The public concerns that are related to the establishment of planning objectives, planning constraints, and establishment of evaluation criteria are:

- Desire to reduce the potential for storm damages to the LOSSAN Rail Corridor rail facilities and rail line operations, located along the beaches of the City of San Clemente;
- Desire to reduce the potential for storm damages to public beach facilities;
- Desire to restore the recreation beach area along the Pacific Coast of the City of San Clemente;
- Desire to preserve the near shore ecosystem that supports commercial lobster, fisherman, and snorkeling activities;
- Desire to preserve and enhance opportunities for surfing along the San Clemente coast;
- Desire to maintain the aesthetic characteristics of the coastal area of the City of San Clemente;
- Desire to improve public access and safety to the recreation beach areas of the City of San Clemente.

4.4 Planning Objectives and Criteria

4.4.1 <u>Objectives</u>

Based on the analysis of the identified problems and opportunities and the existing conditions of the study area, planning objectives were identified to direct formulation and evaluation of alternative plans.

These objectives are:

- Reduce the potential for storm damages to facilities located along the coast of the City of San Clemente including recreation beach facilities and the LOSSAN Rail Corridor.

- Restore and maintain recreation use along the Pacific Coast of the City of San Clemente.

Alternatives are formulated to maximize storm damage reduction and minimize cost. To be recommended, their benefits must exceed their costs by NED criteria (see Economics Appendix). Improvements to safety and recreational opportunities resulting from any alternative are considered incidental to the main objective of reducing storm damages. All alternatives must undergo both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) review processes. The purpose of the Environmental Impact Statement (EIS) is to identify and present information about any potentially significant environmental effects of the alternatives and the recommended plan.

4.4.2 Criteria

Plans are then compared using four formulation criteria suggested by the U.S. Water Resources Council. These criteria are;

- Completeness - Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the action of others.
- Effectiveness – All of the plans in the final array provide some contribution to the planning objectives. Effectiveness is defined as a measure of the extent to which a plan achieves its objectives.
- Efficiency – All of the plans in the final array provide net benefits. Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits.
- Acceptability – All of the plans in the final array must be in accordance with Federal law and policy. The comparison of acceptability is defined as acceptance of the plan to the local sponsor and the concerned public.

4.5 Planning Constraints and Considerations

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. The constraints identified include those public concerns that if violated by an alternative plan would result in the plan not being acceptable to most public interests. It also includes those aspects of the study area generally regulated by government agencies that if adversely impacted would result in the plan being unacceptable. In general, the planning process needs to consider measures to avoid or mitigate any significant adverse impacts associated with the planning constraints. The planning constraints identified in this study should follow the general guidelines listed below.

Engineering and Physical Constraints: The recommended plan presented should be complete and sound, and in sufficient detail to allow development of engineering plans and specifications.

Economic Constraints: Any potential project that is in the Federal interest must display feasibility by satisfying benefit-cost (B/C) criteria. Generally, this ratio must be greater than one to allow Federal participation in continued study and any project proposal. For Environmental Restoration projects, an incremental analysis must be performed to compare cost effectiveness of the alternatives.

Financial Constraints: The sponsoring agency is required to show their ability and willingness to fund their share of any recommended project as required by the Principals and Guidelines.

Environmental Resource and Agency Constraints: Applicable environmental requirements must be met for a feasibility level study. Environmental acceptability must be ascertained; adverse impacts should be avoided if possible or minimized, if avoidance is not possible. An Environmental Impact Statement (EIS) is included with this Report.

Local Constraints (Public Acceptability): The alternative options and plans should be acceptable to the local residents, agencies, organization, and the non-Federal sponsor(s), as well as the interested State and Federal agencies. Unacceptable measures include any visible offshore structure and any structure that significantly impedes beach access, such as rock revetments.

The planning constraints and considerations for this study are the following:

- Impacts to the nearshore ecosystem that supports commercial lobster, fishing industries, and snorkeling activities;
- Impacts on the opportunities for surfing along the Pacific Coast of the City of San Clemente;
- Impacts to any critical habitat that supports Federal or State threatened and endangered species;
- Impacts on water quality characteristics along the coast and near shore areas of the City of San Clemente;
- Impacts on cultural and historic features located in the Study area;
- Impacts on air quality conditions within the study area.

4.6 Preliminary Plan Formulation – Conceptual Alternative Measures Considered

4.6.1 Methodology

The next step in the formulation process is to develop viable alternative plans. The process in developing the viable plans involves several iterations of developing and screening alternative management measures and plans. Plan formulation begins with the largest possible selection of alternatives, and screens them down through finer and finer analysis and comparison. A preliminary screening of the plans narrows the field by eliminating those plans that prove unacceptable or infeasible at a closer look. Measures passing this screening are developed and screened further until a final array of measures is selected. Any implementable combination of these measures may be considered a separate alternative. Each final alternative receives full Feasibility level development, analysis, and comparison.

4.6.2 Preliminary Measures

Alternatives to address the reduction of potential storm damages are developed considering different scopes of plans by varying levels of protection such as protecting only against frequent minor storm events as compared to protecting against the less frequent major storm events. Consideration is also given to protecting certain reaches of the study area as compared to several reaches or the entire study area. For the planning objective involving restoration of beach area for recreation use, consideration is also given to different levels of restoration involving very wide beaches that may only be needed on the highest peak use days, as compared to narrower beaches that are needed for the more frequent peak use days. Alternatives for this objective are also looked at by study reach, where some reaches may have minimal use for recreation. Screening of these alternatives will consider much of the evaluation criteria stated above including economic costs and benefits, environmental impacts, and significant impacts to the planning constraints. Mitigation measures to avoid or minimize these impacts will be incorporated into the alternative plans as necessary. This development and screening process will lead to an identifying set of final alternative plans that will be examined in detail using the system of accounts and tradeoff analysis such that decisions can be made on the best plans from NED, EQ, OSE and RED standpoints and a locally preferred standpoint. From these plans, a plan will be selected for recommendation to Congress for authorization.

Available methods to eliminate or reduce coastal storm damages and shoreline erosion include seawalls and revetments, beach nourishment-with or without groins, and offshore breakwaters. Seawalls and revetments are placed parallel to the shoreline as a last line of defense to protect adjacent land areas from direct wave attack, flooding and erosion. As such, they often provide the most reliable form of shoreline protection; however, they do nothing to increase beach width, and can impede public access to the beach. Beach Nourishment is highly effective at protecting the coastline as long as the beach is maintained. Groins are cross-shore retention structures that act as a barrier to alongshore sediment transport. The amount of sand trapped by the structure depends on the permeability, height, and length of the structure. Offshore breakwaters are effective at retaining sand, but are expensive and require a healthy source of littoral sand to perform their sand trapping function

The following sections briefly discuss each of the measures mentioned above, and indicate whether the measure was screened out or carried forward for further analysis in subsequent sections of the report.

An alternative measure is a feature or activity at a site, which address one or more of the planning objectives. A wide variety of measures were considered, some of which were found to be infeasible due to technical, economic, or environmental constraints. Each measure was assessed and a determination made regarding whether it should be retained in the formulation of alternative plans.

4.6.3 Future without Project

The Corps is required to consider the option of “No Action” or Future without Project as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). The Future without Project scenario assumes that no project would be implemented by the Federal Government to achieve the planning objectives. The No Action Plan forms the basis for comparing the costs and benefits of different alternatives, and is described previously in this report and in the Economics appendix. Since this plan is required by NEPA to be included among the candidate plans in the final array of alternatives, it is described in more detail in the final alternative plans of this chapter. For the purposes of the initial screening, the Future without Project is based on the SCRRA’s maintenance plan, as described in Section 3.2, to the potential damage to the railroad ballast and tracks, but without any measures implemented by the City of San Clemente for the continued erosion and recreation beaches along the entire coast of San Clemente.

4.6.4 Future with Project - Non Structural Measures

Alternative plans can be broken into structural and non-structural categories. Non-structural alternatives include revising management or maintenance practices, or acquiring real estate. Anything that achieves the project objectives without a hard structure is considered a non-structural alternative. For this study, non-structural measures identified include Managed Retreat, and Best Management Practices.

Managed Retreat

Managed Retreat is a term commonly used to describe a policy that restricts or opposes efforts to control long term retreat of the shoreline. It has been used to describe policies ranging from complete removal of all shore protection structures to simply not allowing new structures to be built.

Reducing Potential Storm Damage

Managed retreat of coastal development would include relocation of the railroad and beach facilities. At this time, most of the public beach facilities are located along the backshore in Reach 6. Continued erosion and storm wave attack will likely eliminate any beach area available for recreation use and accordingly the facilities may no longer be needed or minimal facilities such as restrooms being relocated to the landward side of the railroad. The relocation of the railroad is extremely costly and any decision for such relocation is beyond the scope and intent of this study. In this regard it is noted that as part of the no action plan, it is expected that the railroad will continue to upgrade the existing revetment in Reaches 1, 3 5, 7, 9, and 10 and to construct new seawalls in Reaches 2, 4, 6, and 8 (where no revetments are present) to avoid storm damage to its facilities and its operations. Accordingly managed retreat will be considered only to the extent that it may be included as part of the no action plan or without project condition.

Restoration of Beach Area for Recreation

Managed retreat of recreation uses include the continued erosion of the recreation beach area, it is expected that beach use for most recreation activities will be eliminated. Eventually the beach area will be completely lost with the backshore area being fixed by revetment or seawalls placed by the railroad. Some activities such as surfing will likely continue although the quality of the experience would be reduced causing a reduction in the number of visitors. Again, this managed retreat is likely to occur to some degree and will be further defined under the no action plan or without project condition.

Best Management Practices

Sub aerial processes both weaken the underlying bluff structure and contribute to runoff erosion on the surface of the bluff face. Along the study area shoreline, the rate of bluff top retreat caused by runoff is extremely low when compared to the rate caused by wave attack. The local sponsors have already implemented a regime of codes and ordinances to enforce Best Management Practices to reduce groundwater seepage and sub aerial erosion, therefore this will occur both with and without a Federal Project, and does not play a role in plan selection or NED analysis.

4.6.5 Future With Project - Structural Measures

Beach Replenishment

Beach replenishment involves placement of compatible sand from a borrow area outside of the littoral zone to effectively widen the beach. The increased sand buffer distance accommodates short-term sediment losses so that storm waves and run up dissipate over the wider fill profile. Long-term losses and erosion are addressed through periodic renourishment of the fill.

Design Methodology

The beach fill design parameters were determined by considering various combinations of beach-fill widths and different replenishment cycles. Each option has one combination of an initial beach width and a repetitive duration for the subsequent renourishment cycles. The optimal option is the one that yields the maximum net benefit. The Los Angeles District coastal engineering and economics sections developed the model for simulating shoreline change so that a prediction of shoreline morphology over multiple years as waves redistribute sand after it is placed mechanically on the beach could be evaluated. The optimization consisted of finding the beach width and renourishment period that maximized the net benefits while avoiding known sensitive near shore habitat. Beach Nourishment is carried forward into the NED analysis. The concept design is schematically illustrated in **Figure 4-1.**

Beach replenishment can occur using offshore or onshore borrow sites. In general, in the study area, offshore sources have historically been used for several reasons, discussed below.

Offshore Borrow Sites

Prior offshore studies of the area conducted by the Corps of Engineers have identified potential sources of sand suitable for an offshore borrow site. The approximate location of these sites is given in **Figure 4-2**.

Two areas were selected for investigation: offshore of the beach at the City of San Clemente in Orange County, California (Borrow Area #1), and offshore of Oceanside, San Diego County, California (Borrow Area #2). They were located by previous investigations off of Oceanside by the San Diego Association of Governments (SANDAG) (1999) and USACE (1993). Sampled materials encountered off of San Clemente (Borrow Area No.1) were generally a thin layer of unconsolidated silty, very fine-grained sands and sandy silts underlain by sandy siltstone bedrock. These sediments do not represent suitable beach replenishment materials. The second area investigated, “Borrow Area #2”, is located offshore of Oceanside Beach, and is situated between the mouths of the San Luis Rey and Santa Margarita Rivers, and is approximately 37 km (23 miles) from the project site. Sampled materials encountered off of Oceanside were generally fine-medium grained sands with local silty intervals and minor amounts of shell fragments. The preponderance of the sampled material within Borrow Area No.2 was beach-compatible. The samples taken in the 1999 SANDAG Study at Sites SO-8 and SO-9, as described on page 4-17 of the EIS, fall within the physical boundaries of Borrow Area No. 2.

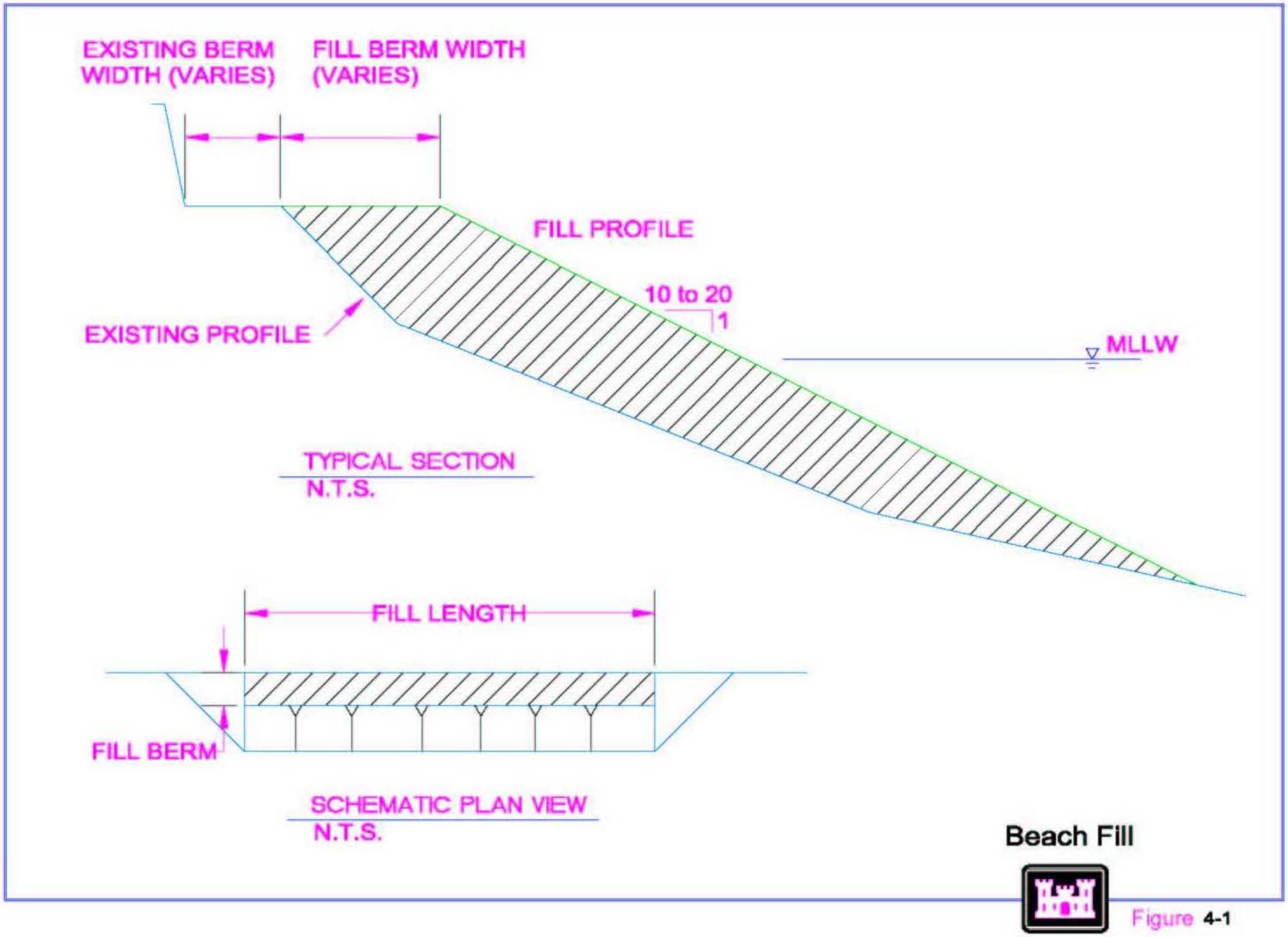
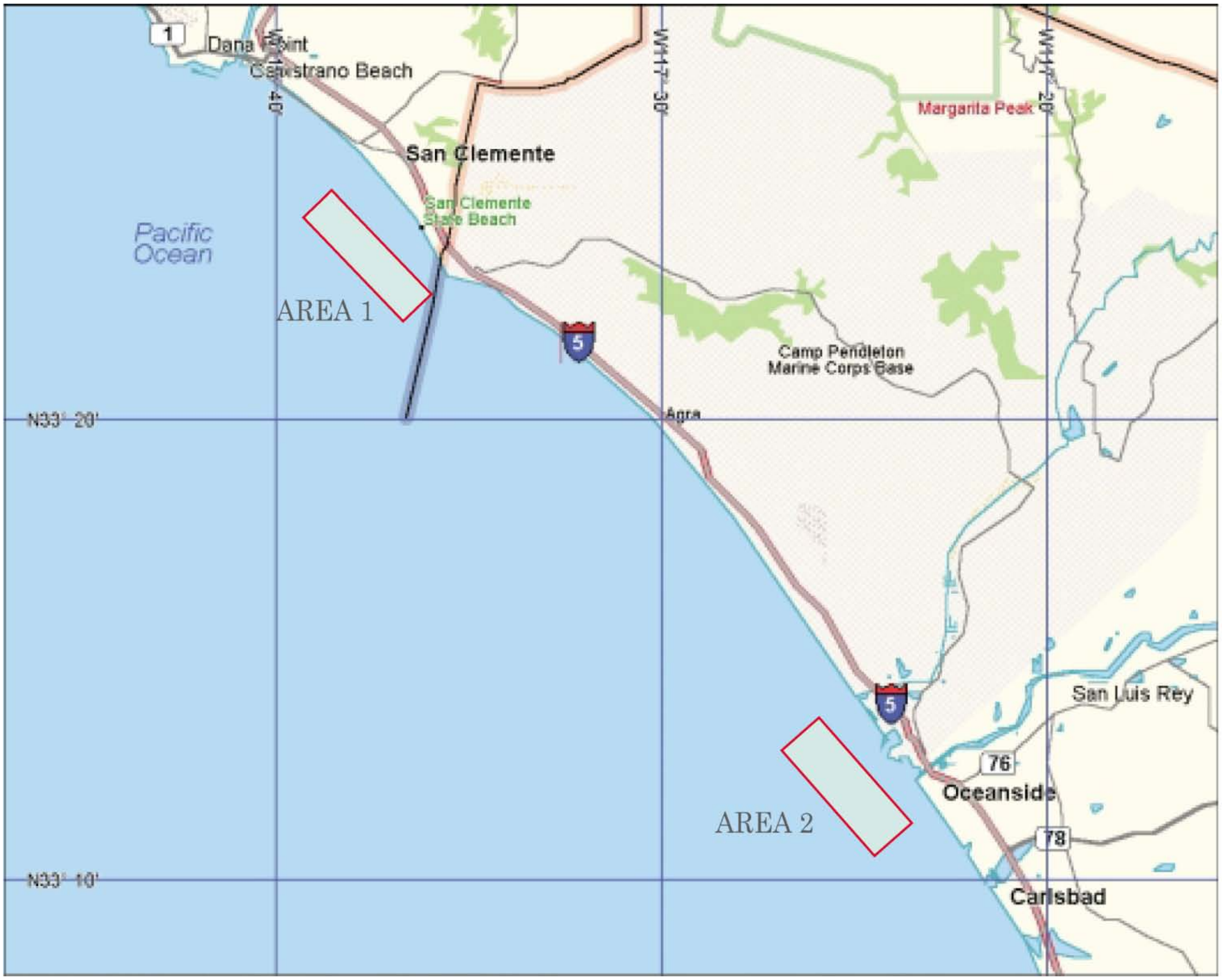


Figure 4-1 Typical Beach Nourishment Design (Beach Fill)



NOTE: Not to Scale

Figure 4-2 Regional Offshore Borrow Sites

Sand Retention

The effectiveness and design of sand retention structures has been studied and documented extensively in Coastal Engineering literature over the last 30 or 40 years. Innumerable empirical relationships have been developed in the laboratory and the field to try to predict the equilibrium shoreline created by a structure of given dimensions at a given location for various conditions. The most recent and relevant of these studies is the SANDAG "*Regional Beach Sand Retention Strategy*" of Oct., 2001, prepared by Moffatt & Nichol Engineers.

The sand retention structures discussed below are only considered in conjunction with a beach replenishment component; because there is little net sand transport in the littoral cell, so the structure would likely trap very little sand without artificial nourishment. The three main classes of sand retention structures and reasons for their inclusion or exclusion from the final analysis are presented in the following sections.

Visible Breakwaters

Breakwaters are concrete or rock walls built roughly parallel to the shore just beyond the breaker zone to absorb wave energy by stopping transmission or breaking the wave before it hits the beach. They can be permeable or solid, depending on the desired amount of wave energy absorption vs. reflection. Preliminary cost estimates were developed by SANDAG for a 50 year life, 305 meter (1,000 foot) long breakwater, with enough beach replenishment to create a 69,000 m^2 (17 acre) beach in the lee of the breakwater (SANDAG). The $33 million cost included 840,000 m^3 (1.1 million cy) of sand initially and an additional 474,000 m^3 (620,000) cy on a 10 year nourishment cycle. Visible breakwaters were considered, however they were screened out of the final analysis for several reasons:

- Extremely high cost,
- Impact on down coast littoral transport,
- Impact on surfing,
- Impact on aesthetics,
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Potential impacts to Essential Fish Habitat
- Public safety issues, and;
- Lack of support from the local sponsor and local community.

- The concept design plan view is schematically illustrated in **Figure 4-3.**

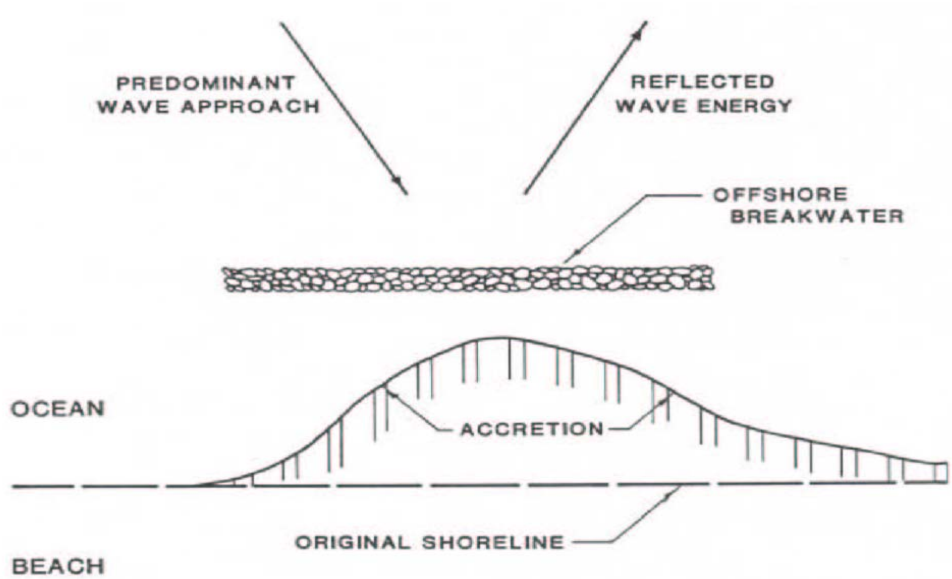


Figure 4-3 Typical Detached Breakwater

Submerged Breakwater/Artificial Reef

Submerged artificial reef type designs come in many forms, but can be roughly broken into "soft" and "hard" designs.

In the soft designs, nearshore sand berms are constructed of dredged sand placed parallel to the beach in shallow water. The "soft" breakwater reduces incident wave height, and gradual onshore migration of the sediment can contribute to renourishment of the adjacent shoreline, provided the berm itself is stable enough to withstand the wave environment. However, this type of design is generally not suited for the type of wave environment in the study area because the relatively small grain sizes of available sand would not be stable when subjected to the wave induced bottom currents. Therefore, soft submerged berms were not carried into the final analysis.

In addition to “soft” submerged breakwaters, “hard” submerged breakwaters, which include “artificial reefs”, were considered. These structures reduce wave energy through breaking and dissipation. They are generally not as effective as surface piercing breakwaters at retaining sand, but do not generally have the adverse effects on surfing conditions that surface visible structures do, and can even enhance surfing conditions if designed for dual purpose. Although much theoretical research has been conducted, real world data on the performance of artificial reefs as sand retention structures is only now becoming available, because few have been built. In addition, most of those were either in Florida or Australia, where conditions differ greatly from the Southern California coastline. Pratte’s Reef was constructed off El Segundo, California out of large geotube sand bags, but was ultimately too small and too far offshore to have any noticeable impact on the shoreline (M&N, SANDAG, Oct 2000). However, extremely high costs, coupled with extremely high uncertainty, severe local opposition to any system of offshore structures on the scale required, and the lack of support from the local sponsors have resulted in this measure being precluded from further consideration.

Groins

Along-shore sand retention structures, such as groins and jetties, are constructed perpendicular to the shore to form fillets that can slow beach erosion by trapping littoral sediment. Most of the littoral drift occurs inshore of the normal breaker line under prevailing wave conditions (about the 2 to 3 meter (7-10 ft) depth contours on the Pacific coast). Hence, extension of sand retention structures beyond about MLLW is generally uneconomical (USACE, 1984).

The shore perpendicular structures are generally utilized to preserve a minimum berm width and slow erosion rates so that renourishment volumes can be lower and episodes less frequent. Groins are often used if their cost is less than the cost savings gained from this reduction in nourishment volume, however, in this case the life cycle costs of constructing groins are likely to exceed any savings in cost of renourishment. The amount of sand trapped by the structure depends on the permeability, height, and length of the structure and the amount of sand in the littoral system. As material accumulates on the updrift side of the structure, supply to the downdrift side is reduced. This results in local beach accretion on the updrift side of the structure and erosion for some distance downdrift. After the beach near the structure adjusts to an “equilibrium” stage in accordance with the wave conditions, all littoral drift will pass the structure either directly over it or divert around the seaward end of the structure. Because of the potential adverse effects on downdrift beaches, groins and similar structures should be used only after careful consideration of the factors involved.

Groins were considered, but this measure would have the potential for the following reasons:

- Impact on down coast littoral transport;
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Potential impacts to EFH due to lost habitat area occupied by construction footprints and/or turbidity impacts
- Impacts to lateral beach access
- Life cycle costs of constructing groins are likely to exceed any savings in cost of renourishment
- Lack of support from the local sponsor and local community, and
- Impact on aesthetics.

The concept design is illustrated in **Figure 4-4.**

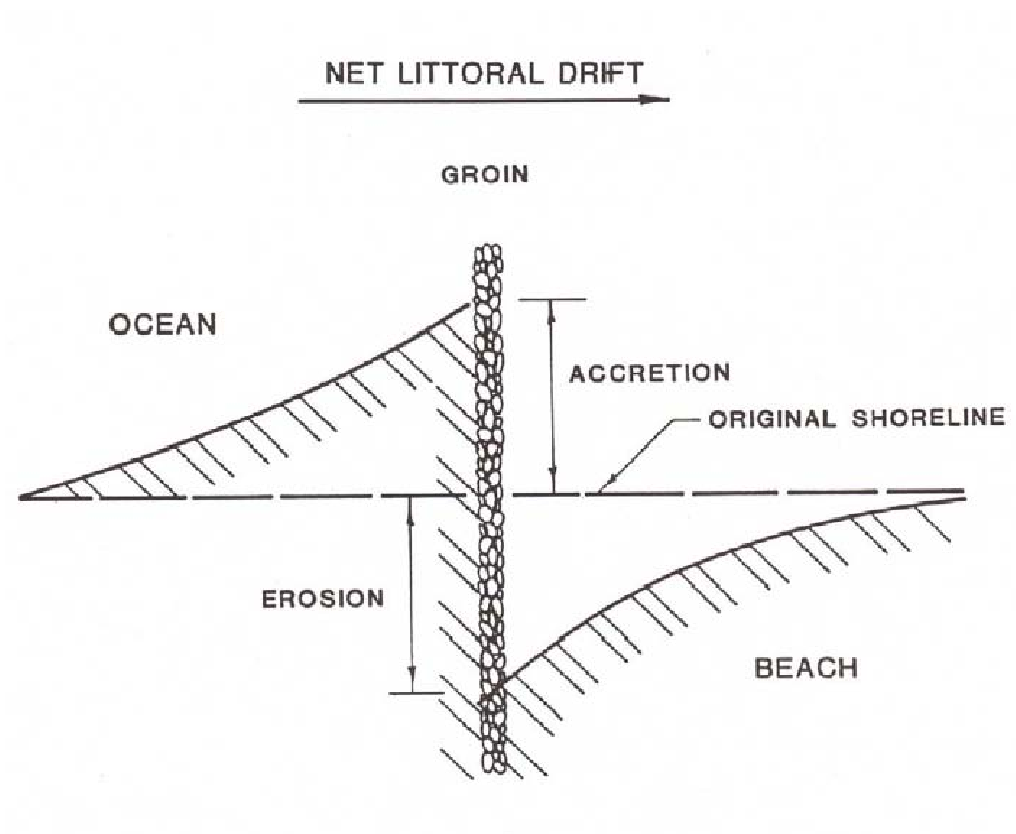


Figure 4-4 Typical Groin

Seawalls

A seawall can be considered for remedying coastal flooding and shoreline erosion, particularly at a low-lying and narrow beach. A seawall with a relatively small footprint terminates the shoreline retreat at the seawall location. However, it requires relatively high crest elevations to prevent the high waves rushing up along the vertical face from overtopping. Continued erosion of the shoreline and construction of seawalls, without beach nourishment, will lead to the absence of a beach of any width. This condition could drastically reduce the possibility for the presence of favorable surfing conditions, by changing the nearshore beach profile. Seawalls were considered, however they were screened out of the final analysis for several reasons:

- o Extremely high cost (initial construction approximately $31M),
- o Impact on down coast littoral transport,
- o Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- o Public safety issues,
- o Lack of support from the local sponsor and local community,
- o Impact on surfing, and;
- o Impact on aesthetics.

A conceptual design is schematically illustrated in **Figure 4-5.** Note that although titled "San Clemente Seawall Section," Figure 4-5 is only a conceptual example and does not represent a constructed or designed seawall at San Clemente as neither currently exist. The seawall was assumed to be steel reinforced concrete structure founded on bedrock. This type of structure is not common in the southern California shoreline area.

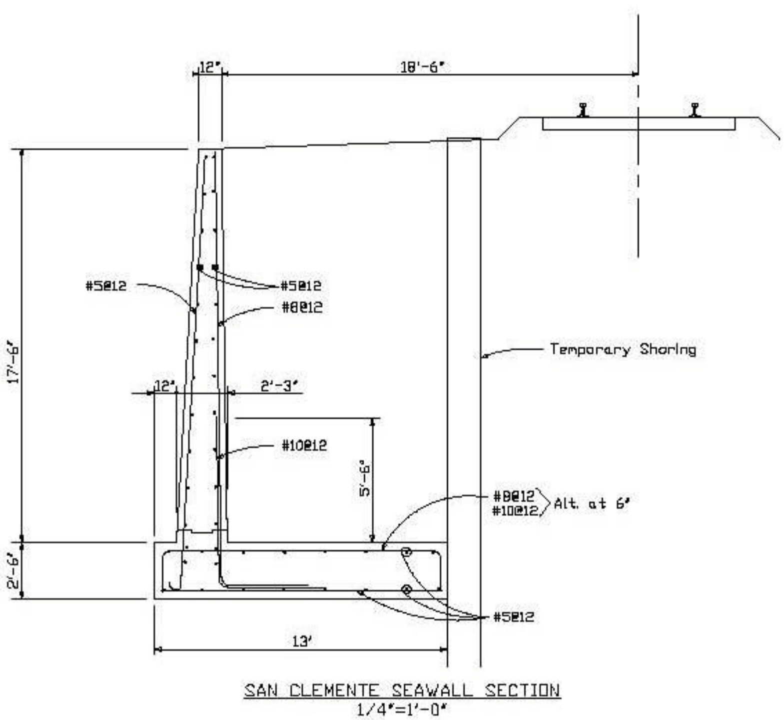


Figure 4-5 Schematic of Typical Seawall Design

Revetments

Revetments are structures made of placed quarry stone designed to protect the bluff toe from erosion by wave action. They are typically built of 2,700 to 4,500 kg (3 to 5 ton) stone over a layer of smaller stone over a layer of fill. Revetments are generally effective if maintained, but encroach significantly onto the beach and in most cases into the surf zone. Continued erosion of the shoreline and construction of engineered revetments, without beach nourishment, will lead to the absence of a beach of any width. This condition could drastically reduce the possibility for the presence of favorable surfing conditions, by changing the nearshore beach profile. Revetments were considered, however they were screened out of the final analysis for several reasons:

- Impact on down coast littoral transport,
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Public safety issues,
- Public access impacts to pedestrians to gain access from the landside as well as lateral access along the beach,
- Lack of support from the local sponsor and local community,
- Potential impacts to EFH due to lost habitat area occupied by construction footprints and/or turbidity impacts,
- Impact on surfing,
- Impact on recreation by reducing the amount of usable beach space, and;
- Impact on aesthetics.

The conceptual design is schematically illustrated in **Figure 4-6.**

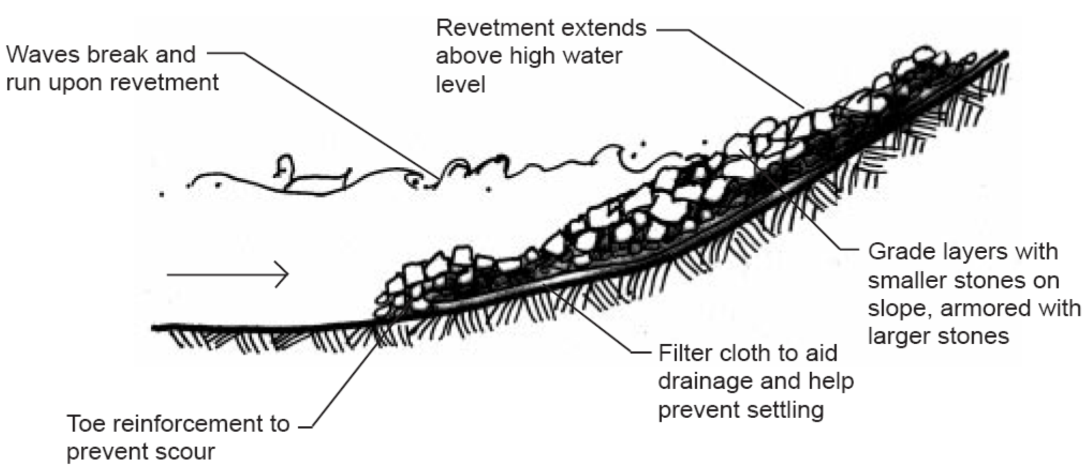


Figure 4-6 Schematic of Typical Revetment

4.6.6 Summary of Alternatives

The management measures that become the alternative plans also must follow the following guidelines. After reviewing the possible alternatives that were considered for the project only the beach fill alternatives were carried forward into the final array. Although all of the screening criteria were deemed important, the primary screening criteria included potential permanent and temporary impacts on Essential Fish Habitat, inconsistencies with the Coastal Zone Management Act, and project costs. Construction footprints for either breakwaters or groins would potentially have a permanent impact on Essential Fish Habitat. Consistency with the Coastal Zone Management Act was a criteria for eliminating breakwaters, groins and revetments. The high cost of implementing the remaining alternatives, compared to beach nourishment, would not maximize NED benefits and achieve the Planning Objectives.

Technical Feasibility - The recommended plan presented should be complete and sound, and in sufficient detail to allow development of engineering plans and specifications.

Economic Feasibility - Any potential project that is in the Federal interest must display feasibility by satisfying benefit-cost (B/C) criteria. Generally, this ratio must be greater than one to allow Federal participation in continued study and any project proposal. In addition, the sponsoring agency is required to show their ability and willingness to fund their share of any recommended project as required by the Principles and Guidelines.

Environmental Impacts - Applicable environmental requirements must be met for a feasibility level study. Environmental acceptability must be ascertained; and adverse impacts should be avoided if possible or minimized if avoidance is not possible. The screening of alternatives based on environmental acceptability limitations are done with respect to Federal environmental statutes. Federal examples of these include the Coastal Zone Management Act (CZMA) and the Fish and Wildlife Coordination Act (FWCA). The California Coastal Commission currently interprets the CZMA in such a way that favors almost any type of shore protection over rock revetments and/or seawalls, especially in areas where there is a lot of public beach use and recreation. A revetment of this size would have very little chance of obtaining a Coastal Consistency Determination.

Public Acceptability - The alternative options and plans should be acceptable to the local residents, agencies, organization, and the non-Federal sponsor(s), as well as the interested State and Federal agencies. The local sponsor has indicated that they are severely constrained by public opinion and cannot support any recommendation that meets with severe public opposition. Unacceptable plans include any visible offshore structure and any structure that significantly impedes beach access, such as rock revetments. Local, well organized and well funded citizens groups have expressed strong opposition to revetments both in public meetings and in litigation. Any proposed project including revetment would encounter severe opposition from these groups.

Table 4-1 compares the management measures to the evaluation criteria.

Table 4-1 Comparison of Evaluation Criteria

Management Measure	Meets Purpose and Need	Technically Feasible	Economically Feasible	Environmentally Acceptable	Acceptable to Public
Beach fill	Yes	Yes	Yes	Yes	Maybe
Managed Retreat	Maybe	Yes	No	No	Maybe
Revetment	Maybe	Yes	Maybe	No	No
Seawall	No	Yes	Yes	No	No
Groin	Yes	Maybe	No	No	No
Visible Offshore Breakwater	Maybe	Yes	No	No	No
Submerged Reef	Maybe	No	No	Maybe	Maybe

4.7 Final Alternatives Analysis

The study team identified a beach fill as the only viable protection alternative given the environmental and institutional constraints of the study area. The economic optimization procedure is based on selection of beach fill alternatives which produces the NED plan. The NED plan is developed by considering the recreational potential and storm damage reduction of various beach fill configuration alternatives and optimization based on the average annual benefits and the benefit/cost ratio. The only optimization parameter presented is the dimension of the sacrificial beach width of the cross-sectional design profile. Base beach width alternatives, beyond the current conditions of the beach, were considered in this study, however, the residual with project damages are minimal with the existing beach, so the benefits of maintaining a wider beach are marginal. The storm damage reduction benefits, in this study, are derived from maintaining the existing beach conditions by constructing a sacrificial beach. The twelve alternatives evaluated consist of sacrificial beach widths (m) = {10, 15, 20, 25, 30, 35, 40, 45, 50, 60}. For reference, example schematic of a typical beach fill {15 meter (50 foot) width} is presented in Figure **4-7**, and will be discussed further in this Chapter.

Sacrificial Beach Width

The sacrificial beach width is the amount of beach added to the base beach width. The sacrificial beach width is allowed to erode to the base beach width, after which the sacrificial beach width is replaced. The sacrificial beach width represents a time-varying amount of storm damage reduction protection and a time-varying amount of recreation benefits.

Nourishment Interval

The sacrificial beach width represents a period of time between successive nourishments. The sacrificial beach width divided by the mean long term erosion rate will yield an approximate value for the nourishment interval. For example, a 20 m (66 ft) sacrificial beach width divided by 4.0 m/yr (13 ft/yr) long term erosion rate approximately equals a 5 year periodic nourishment interval. During the Monte Carlo simulation the sacrificial beach width will last varying lengths of time reflecting the random nature of the erosion processes, but the final output can be expressed in a mean number of years between successive fills. Therefore, optimization of the sacrificial beach width will yield the periodic nourishment interval.

Alongshore Length

Approximately 1,040 m (3,412 ft) of shoreline within the City of San Clemente are recommended for nourishment. The area is approximately centered about the Pier; the south limit of the proposed beach fill is located immediately south of the T-Street overpass while the north limit is located immediately north of the Marine Safety Headquarters. A taper continues an additional 100 m (330 feet) to the north and south to merge with the existing shoreline. No benefits from the tapering effects are counted. For the extreme sea level rise case, a taper continues an additional 150 m (490 feet) to the north and south to merge with the existing shoreline.

Berm (Beach) Width

The design berm width is a direct result of the model optimization, which is more fully explained in Appendix D of the EIS/EIR. The initial fill profile is expected to evolve thru an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile. The overfill material is added to the design quantity to account for the equilibration process.

Berm (Beach) Crest Elevation

Current design guidance recommends the elevation of the design berm should generally correspond to the natural berm crest elevation. If the design berm is lower than the natural berm, a ridge will form along the crest, which when overtopped by high water will produce flooding and ponding on the berm. A design berm higher than the natural berm will produce a beach face slope steeper than the natural beach and may result in formation of scarps that interfere with recreational use and other environmental uses. Scarp formation indicates a higher transport (erosion) rate than a berm at the natural elevation, which is an inefficient use of beach fill material.

The design berm elevation for the existing sea level rise condition is established at +5.2 meters MLLW (+17 ft). This elevation matches the natural berm of adjacent healthy beaches which have been established by numerous surveys over the years. Historical beach profiles measured over the years indicate natural, stable berm elevations are approximately +5.2 meters MLLW (+17 ft). The berm crest elevation is the same for both the existing sea level rise case and the extreme sea level rise case.

The design berm elevation for the extreme sea level rise condition is expected to be +5.9 meters MLLW (+19.4 ft). This elevation is the sum of the existing beach berm elevation and the extreme sea level rise. There is no known methodology to predict the future beach berm crest elevation in response to extreme sea level rise. The extreme sea level rise assumption results in an increase of the mean long term erosion rate by 0.7 m/yr (2.3 ft/yr). The beach berm elevation tends to be the natural upper limit of run-up. It is assumed that the beach will respond by increasing the berm elevation an amount exactly equal to sea level rise to preserve its natural run-up characteristics.

Foreshore Slope

The design foreshore slope is established at 8H:1V. The foreshore slope is the same for both the existing sea level rise case and the extreme sea level rise case. This slope matches the natural foreshore slope of adjacent beaches which have been established by numerous surveys and measurements over the years. Direct measurements obtained by the City of San Clemente indicate natural, stable foreshore slopes range between 4-18H:1V, with 8H:1V as the most common value. This slope has been shown to be a stable mean value between the seasonal variations.

The construction foreshore slope is established at 10H:1V. Los Angeles District beach fill construction experience with standard earthmoving equipment indicates that slightly flatter foreshore slopes are easier to construct. The post-construction foreshore is expected to evolve thru an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile.

Quantity

Engineering practice in southern California indicates volume/area relationships are the most reliable predictor for fill quantities. The horizontal area of the beach fill planform is computed and multiplied by a volume/area factor. It is usual and customary in southern California that this volume/area relationship ranges between 4.1-12.3 m^3/ m^2 (0.5-1.5 yd^3/ft^2). The low range of 4.1 m^3/ m^2 (0.5 yd^3/ft^2) has been shown to result in rapid erosion of the fill. The range of 8.2-12.3 m^3/ m^2 (1.0-1.5 yd^3/ft^2) typically yields more realistic estimates of sediment requirement per surface area. The value of 12.3 m^3/ m^2 (1.5 yd^3/ft^2) is used in the present study. It is expected that this quantity will have the greatest in-place stability.

4.7.1 With Project Alternatives Analysis

The without project model was adapted to simultaneously analyze both with and without project conditions with each alternative being compared to the same conditions of the without project analysis. Comparisons between with and without project were accomplished through a fixed seeded storm application. Under this constraint, the model processed the without and alternatives conditions under the exact same storm sequence. The results for without project and the alternatives were then matched paired through @RISK to compare how an alternative compares to the without project condition under the same storm sequence.

The with project conditions starts with a beach fill and is subject to the same storm as the without project condition. Damages are then computed from the storm induced erosion – erosion amounts being identical to the without project condition – but the beach starting points being offset by the fill amount. After recreation and damages are calculated, the beach is allowed to erode to the next year's starting position.

At the start of the next year, the model examines if any beach fill remains. If there is beach fill remaining the model calculates damages as previously described. If the entire beach fill has been eroded, the model requires a renourishment to the original program size. The model processes go on for the 50 years of the period of analysis and comparing the Net Present Value (NPV) streams of with and without for each iteration. The number of iterations was set at 1000. Thus, the model compares 1000 50-year forecasts to develop its distributions. This process was utilized for all alternatives.

4.7.2 With Project Model Assumptions

In addition to the without project assumptions previously discussed in Sections 3.2 and 4.7.3, the with-project model includes:

- Long-term beach fill erosion rate (ft/yr) defined as Risktriang (-15.2m, -5.5m, 9.1m) (-50 ft, -18.1 ft, 30 ft)
- An expected cost of sand at $15.36 per cubic yard
- An expected cost of mobilization/demobilization of $2,124,200.
- Initial project Pre-Construction Engineering and Design (PED) of 10% of construction cost with renourishment PED costs of $250,000
- Supervision and Administration (S&A) costs at 6.5% of construction cost
- Environmental mitigation costs of $360,000 at construction and replenishment
- Environmental offshore construction cost of $2,300,000 for fills in excess of 15 meters
- Interest During Construction cost based on a mid-term full expenditure pattern approach
- Dredge capacity of 127,000 m^3 (166,200 yd^3) per month (based on recent performance statistics of the Portland District's Hopper Dredge "Yaquina")
- A renourishment program based on an as needed approach
- No Seawall Construction occurs

4.7.3 Project Alternatives

The with-project alternatives consist of 11 alternative fill profiles starting at 10 meters (33 ft) and increasing by 5 meters (16 ft) to a maximum of 60 meters (197 ft), in addition to the Without Project condition:

The R/U model for San Clemente was simultaneously run with all alternatives to ensure that all comparisons of alternatives were conducted under the exact same conditions. Each alternative was evaluated for 1000 simulations of 50-yr projections. A brief model explanation is below:

- If the entire beach fill has been eroded, the model requires a renourishment to the original program size. For example, if the original with-project condition was a 20 meter (66 foot) beach fill program – the model monitors the remaining fill and when the fill reaches 0, the model renourishes the beach with 20 meters (66 ft) of fill. Given the random nature of long-term beach fill erosion, the model does not operate under a fixed interval of renourishment; but, is instead a fill-as-needed approach. As a result it is possible that the model would produce higher costs for a smaller (i.e. narrower) required beach fill width because of the need for more frequent renourishment events. More frequent renourishment cycles results in a greater number of events throughout the 50-year period of analysis, adding to the total cost of the project, which includes mob/demob as well as contracting, engineeirng and monitoring costs for each cycle. Examples of this are shown in **Tables 4-2** and **4-5**, where a 10-m (33 ft) beach width requires a greater Total Life Cycle (NPV) cost than a 15-m (50 ft) beach width.

The results of the model are presented in the series of tables below.

4.7.4 NED Benefits – Alternatives Comparison

ER 1165-2-130 restricts incidental recreation benefits to an equal amount of coastal storm damage reduction benefits when the project's storm damage reduction benefits on their own do not justify the project. All of the alternatives analyzed do not possess a B/C ratio greater than 1 on coastal storm damage reduction benefits alone. Therefore, each alternative has a restricted recreational benefit equal to the amount of coastal storm damage reduction benefits for the alternative. NED plan selection calls for the alternative with the greatest amount of net NED benefits, based on storm damage reduction benefits only, to be designated as the NED plan. The alternative with the greatest net NED benefits is Alternative 2 – 15 meter beach fill. The net annual NED benefits for Alternative 2 are -$41,581. Taking into account the recreation benefits, Alternative 2 has a B/C ratio of 1.88, on a restricted basis (**Table 4-2**).

Identification of Alternative 2 as the NED Plan can be seen in **Table 4-2** below, where Alternatives 1 and 3 (10 meter and 20 meter beach fills, respectively) both express lower net annual storm damage reduction benefits. The 10 meter plan also requires a higher annual cost than the 15 meter plan due to the need for more frequent re-nourishments (roughly 11 re-nourishments needed as opposed to 8 over the project lifetime). The 20 meter plan and all plans wider require a higher annual cost due to much higher sand costs. The 15 meter plan displays the highest B/C ratio based on storm damage reduction benefits and recreation combined and the greatest net NED benefits based on storm damage reduction benefits.

Table 4-2 – Analysis of Alternatives

FY11 Prices and Discount Rate

BASE SEA LEVEL RISE CONDITION												
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,420,018	$43,148	$35,540	$31,466	$28,614	$26,668	$24,713	$23,475	$21,791	$21,097	$20,328	$19,912
RR Construction & O&M Costs	$1,275,274	$15,629	$13,127	$11,548	$10,523	$9,798	$9,315	$8,911	$8,582	$8,354	$8,124	$7,994
Trail Damage	$81,821	$6,704	$6,400	$6,212	$6,085	$5,996	$5,934	$5,884	$5,847	$5,816	$5,787	$5,769
Structure & Content Damage	$62,923	$20,815	$16,014	$13,707	$12,007	$10,874	$9,464	$8,679	$7,362	$6,927	$6,417	$6,150
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,420,018	$43,148	$35,540	$31,466	$28,614	$26,668	$24,713	$23,475	$21,791	$21,097	$20,328	$19,912
Damage Reduction	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Incidental Recreation:												
W/O Project Reach 6	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923
With Project Reach 6	$10,667,923	$12,066,458	$12,328,344	$12,599,809	$12,890,901	$13,179,733	$13,429,489	$13,630,218	$13,814,365	$13,971,137	$14,103,567	$14,223,486
Incidental Recreation Improvement	$0	$1,398,535	$1,660,421	$1,931,886	$2,222,978	$2,511,810	$2,761,566	$2,962,295	$3,146,442	$3,303,214	$3,435,644	$3,555,563
Average UDV Reach 6	$5.24	$6.17	$6.30	$6.43	$6.57	$6.71	$6.84	$6.94	$7.03	$7.11	$7.18	$7.24
Weekend Sqft - Summer	30.00	39.09	44.79	50.59	56.28	62.26	68.27	74.10	80.23	86.48	92.70	99.31
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,985*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$225,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,856,030*	*$14,381,610*	*$15,911,115*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	11.83	9.11	7.49	6.40	5.61	5.00	4.53	4.15	3.82	3.55	3.33
Annual Costs	$0	$1,482,807	$1,469,767	$1,590,821	$1,618,043	$1,647,458	$1,681,676	$1,718,399	$1,760,583	$1,798,508	$1,840,874	$1,885,742
Storm Damage Reduction (SDR) Benefits	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Net Annual SDR Benefits	$0	-$105,937	-$85,289	-$202,269	-$226,639	-$254,108	-$286,370	-$321,856	-$362,356	-$399,588	-$441,184	-$485,637
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Total SDR & Recreation Benefits - Limited	$0	$2,753,740	$2,768,955	$2,777,103	$2,782,807	$2,786,700	$2,790,610	$2,793,087	$2,796,454	$2,797,841	$2,799,380	$2,800,211
B/C Ratio - SDR only		0.93	0.94	0.87	0.86	0.85	0.83	0.81	0.79	0.78	0.76	0.74
B/C Ratio - SDR & Recreation (Limited)		1.86	1.88	1.75	1.72	1.69	1.66	1.63	1.59	1.56	1.52	1.48
Annual Net NED Benefits (Limited)		$1,270,933	$1,299,188	$1,186,282	$1,164,764	$1,139,242	$1,108,935	$1,074,687	$1,035,871	$999,333	$958,506	$914,469
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$1,398,535	$1,660,421	$1,931,886	$2,222,978	$2,511,810	$2,761,566	$2,962,295	$3,146,442	$3,303,214	$3,435,644	$3,555,563
Total SDR & Recreation Benefits - Unlimited		$2,775,405	$3,044,898	$3,320,437	$3,614,381	$3,905,161	$4,156,871	$4,358,838	$4,544,669	$4,702,134	$4,835,335	$4,955,669
Annual Net NED Benefits - Unlimited		$1,292,598	$1,575,131	$1,729,617	$1,996,338	$2,257,703	$2,475,196	$2,640,439	$2,784,086	$2,903,626	$2,994,460	$3,069,926
B/C Ratio - SDR & Recreation - Unlimited		1.87	2.07	2.09	2.23	2.37	2.47	2.54	2.58	2.61	2.63	2.63

4.8 The NED Plan – Alternative 2

Table 4-2 presents the model's output data for the analysis of Alternative 2. Alternative 2 would extend the beach 15 meters, from the location of the existing edge of the berm at the +5.2 m elevation, at a first cost of $7,516,590 for the initial beach fill. Expected costs for the initial fill would be: $3,865,478 for sand; $2,124,896 for mob/demob; $26,805 for IDC; and $1,499,411 for PED, S&A, and environmental mitigation. Over the 50-yr period of analysis the project would require approximately 8 additional renourishments beyond initial construction on average with a range of fills between 5 and 15. The initial fill, and 7 of the 8 renourishments, will require approximately 192,000 m^3 (251,000 CY) of beach compatible sand. The last renourishment event will require 64,000 m^3 (84,000 CY), requiring less sand so that the project life is not extended by the 50 year period of analysis. The total life-cycle cost of the alternative is $1,469,767 on an annual basis.

Alternative 2 would reduce coastal storm damage on an average annual basis from $1,420,018 to $35,540 – a 99.0% reduction. The major reduction in damages is the avoided cost savings from railroad (principally, seawall) construction. The beach fill program eliminates the need for seawall construction. The Without Project railroad construction and O&M costs (**Table 4-3**) fall from $1,275,274 to $13,127 under Alternative 2. Structure and content damages under Alternative 2 are reduced by 74% and damages to the trail system fall 92%.

Table 4-3 Alternative 2 Damage Reductions (Average Annual)
FY11 Price Levels

Category	W/O Project	Alternative 2	Reduction	% Reduction
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147	99.0%
Trail Damage	$81,821	$6,400	$75,421	92.2%
Structure & Content Damage	$62,923	$16,014	$46,909	74.5%
RR Delay Costs	$0	$0	$ 0	00.0%
Total Damages	$1,420,018	$35,540	$1,384,478	97.5%

Alternative 2 has a large impact on recreation. The most notable impact is the effect on summertime weekend user space. Under the Without Project condition, summertime weekend space falls to 30 ft^2 throughout the period of analysis. Under Alternative 2, summertime weekend user space increases to 44.8 ft^2, on average. Although this space is well below the ideal use allotment of 100 ft^2, the beach is no longer congested and will be able to service future demand growth. Alternative 2 increases the overall annual use value of the beach from $5.24 to $6.30 per user. Total recreation value on an average annual basis increases from $10,667,923 to $12,328,344 – a $1,660,421 increase.

ER 1105-2-100, Appendix E, Section IV, E-24.c. states:

> *"Shore protection projects are formulated to provide hurricane and storm damage reduction. Recreation is incidental. The Corps participates only in those projects formulated exclusively for hurricane and storm damage reduction, and justified (BCR ≥ 1.0) based solely on damage reduction benefits, or a combination of damage reduction benefits plus (at most) a like amount of incidental recreation benefits. In other words, recreation benefits useable to establish Corps*

participation may not be more than fifty percent of the total benefits required for justification, which in turn means they may not exceed an amount equal to fifty percent of costs. If the criterion for participation is met, then all recreation benefits are included in the BCR."

Table 4-2 indicates that on a restricted basis Alternative 2 exceeds a B/C ratio of 1 and meets the criterion for participation. Therefore, under the above section all recreation benefits are to be included in the BCR for Alternative 2. The total unlimited NED benefits for Alternative 2 are shown in **Table 4-4**.

Table 4-4 Alternative 2 NED Net Benefits & B/C Ratio
FY11 Price Levels and Discount Rate

Category	W/O Project	Alternative 2	Benefits/Costs
Structural Damages - Annual			
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147
Trail Damage	$81,821	$6,400	$75,421
Structure & Content Damage	$62,923	$16,014	$46,909
RR Delay Costs	$0	$0	$ 0
Total Damage/Reduction	$1,420,018	$35,541	$1,384,477
Recreation – Annual			
Total Recreation Value	$10,667,923	$12,328,344	$1,660,421
Total Annual Benefits			$3,044,898
Annual Costs			$1,429,767
Annual Net Benefits (unlimited)			$1,575,131
B/C Ratio (unlimited)			2.07

4.8.1 <u>Risk & Uncertainty of the NED Plan</u>

Further justification for the NED Plan can be seen through a Risk & Uncertainty (R/U) Analysis (detailed in the Economics Appendix) of implementing the plan based on comparison of without and with project damages. As stated in the Economics Appendix, the average annual value of the without project damages is $1,420,018 and that of the NED Plan is $35,541, producing a total damage reduction of $1,384,477.

Comparison of without and with project damages show that the with project damages are only a fraction (less than 5%) of the without project damages, thus strongly verifying economic justification for implementation of the NED Plan. The with project damages are primarily comprised of damages to structures and minor costs associated with repairs and maintenance of protection for the railroad tracks. With project residual damages are minimal because erosion of the placed fill will be monitored and future renourishment will be implemented as required, thus negating the need for construction of a seawall or other structures rather than renourishing with beach compatible sand.

4.8.2 The NED Plan – Sea-Level Change Sensitivity Analysis

USACE issued the Engineer Circular titled, "Water Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" on July 1, 2009. The circular provides USACE guidance for incorporating the potential direct and indirect physical effects of projected future sea level change in the engineering, planning, design, and management of USACE projects. The guidance states that potential sea level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. USACE requires a multiple scenario approach to address uncertainty and help develop better risk-informed alternatives. Planning studies and engineering designs should consider alternatives that are developed and assessed for the entire range of possible future rates of sea level change. The alternatives should be evaluated using "low", "intermediate", and "high" rates of future sea level change for both "with" and "without" project conditions. The historic rate of sea level change should be used as the "low" rate. The "intermediate" rate of local mean sea level change should be estimated using the modified Curve I from the National Research Council (NRC) 1987 report titled "Responding to Changes in Sea Level: Engineering Implications". The "high" rate of local sea level change should be estimated using the modified Curve III from the 1987 NRC report. This "high" rate exceeds the upper bounds of IPCC estimates from both 2001 and 2007 to accommodate for the potential rapid loss of ice from Antarctica and Greenland. The sensitivity of alternative plans and designs to the rates of future local mean sea level change should be determined. Design or operations and maintenance measures should be identified to minimize adverse consequences while maximizing beneficial effects. For each alternative sensitive to sea level change, potential timing and cost consequences should be evaluated during the plan formulation process.

Historic trends at San Diego, California indicate a positive sea level rise of +2.45 mm/yr based on water level measurements during the period 1950-1999. If past trends are projected into the future at San Diego, a sea level rise of 0.12 m (0.4 ft) would be expected during the 50 year period of economic analysis. The NRC Curve III estimates sea level rise, during the 50 year economic period of analysis, to be 0.70 m (2.3 ft).

Relative sea level rise has project impacts from two primary considerations: 1) long-term beach erosion, and 2) increased wave run-up and overtopping. The effects of sea level rise are addressed in Appendix D of the EIS/EIR.

The NED Plan is formulated on the basis of continuous monitoring of beach fill erosion and renourishment. This monitoring would be expected to identify any rapid change in sea level through an unanticipated change in renourishment requirements. Although sea level change should be identified through the frequency of renourishment, the NED Plan still requires an assessment of how sensitive its performance is to sea level change.

To examine the NED Plan under sea level change a sensitivity analysis was performed , based on the NRC Curve III, assuming a maximum sea-level rise of 0.70 meters over 50-years, as a point of reference the base case assumes a sea-level rise of 0.12 meters. This sea level change was incorporated into the model along with an adjustment to the construction cost of the seawall and simulated over the array of alternatives.

The results of the sensitivity analysis are shown in **Table 4-5**. As expected, a higher future sea-level rise increases the potential for storm damages. Storm damages increase under the without project condition from the base case's $1.42 million to $1.76 million for the maximum sea-level rise case on an average annual basis. Approximately 80% of the increase in damages is related to the seawall. Under maximum sea-level rise construction of the seawall occurs six years sooner (2015 vs. 2021) and at a higher construction cost. The maximum sea-level rise and mid-range conditions do not produce a change in NED Plan identification of Alternative 2. On a performance basis, the base case NED Plan reduces annual storm damages by about 98%, Alt 2 for the mid-range sea-level by 97%, and the maximum sea-level rise condition by 96% with Alt 2.

In addition to its performance level under sea-level rise conditions, the base case NED Plan of 15 meters requires less than one additional fill on average over the 50-year project life - 9.11 fills versus 9.49 for the mid-range and 9.66 for maximum. These results indicate that the base case NED Plan of a beach fill project of 15 meters is manageable with monitoring and unlikely to carry a significant degree of risk.

Table 4-5 – Sea-Level Rise Sensitivity – Maximum

FY11 Price Levels & Discount Rate

MAXIMUM SEA LEVEL RISE CONDITION												
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,764,479	$88,023	$70,655	$59,659	$52,558	$47,407	$43,096	$39,644	$37,050	$34,721	$33,899	$31,901
RR Construction & O&M Costs	$1,548,017	$24,129	$19,347	$16,768	$14,890	$13,571	$12,575	$11,712	$11,004	$10,499	$10,124	$9,725
Trail Damage	$93,756	$8,040	$7,449	$7,130	$6,881	$6,711	$6,586	$6,478	$6,392	$6,329	$6,279	$6,232
Structure & Content Damage	$122,706	$55,854	$43,859	$35,761	$30,787	$27,125	$23,935	$21,454	$19,654	$17,893	$17,496	$15,945
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,764,479	$88,023	$70,655	$59,659	$52,558	$47,407	$43,096	$39,644	$37,050	$34,721	$33,899	$31,901
Damage Reduction	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,921	$1,717,071	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,577
Incidental Recreation:												
W/O Project Reach 6	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571
With Project Reach 6	$9,868,571	$11,957,051	$12,265,743	$12,553,597	$12,861,174	$13,158,165	$13,418,683	$13,629,867	$13,803,937	$13,968,191	$14,107,659	$14,227,080
Incidental Recreation Improvement	$0	$2,088,481	$2,397,172	$2,685,026	$2,992,604	$3,289,595	$3,550,112	$3,761,296	$3,935,366	$4,099,621	$4,239,088	$4,358,509
Average UDV Reach 6	$4.75	$6.08	$6.25	$6.40	$6.55	$6.69	$6.83	$6.94	$7.02	$7.11	$7.18	$7.24
Weekend Sqft - Summer	30.00	38.12	44.00	49.99	55.96	61.97	68.09	74.11	79.92	86.26	92.78	99.10
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,985*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$225,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,856,030*	*$14,381,610*	*$15,911,115*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	12.85	9.66	7.87	6.68	5.84	5.22	4.72	4.28	3.96	3.68	3.43
Annual Costs	$0	$1,575,028	$1,539,981	$1,655,446	$1,674,771	$1,702,088	$1,735,340	$1,772,492	$1,803,478	$1,844,585	$1,887,256	$1,928,398
Storm Damage Reduction (SDR) Benefits	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,921	$1,717,071	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,577
Net Annual SDR Benefits	$0	$101,428	$153,843	$49,374	$37,150	$14,983	-$13,957	-$47,657	-$76,050	-$114,828	-$156,676	-$195,821
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,921	$1,717,071	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,577
Total SDR & Recreation Benefits - Limited	$0	$3,352,912	$3,387,647	$3,409,640	$3,423,841	$3,434,142	$3,442,765	$3,449,669	$3,454,856	$3,459,515	$3,461,160	$3,465,154
B/C Ratio - SDR only		1.06	1.10	1.03	1.02	1.01	0.99	0.97	0.96	0.94	0.92	0.90
B/C Ratio - SDR & Recreation (Limited)		2.13	2.20	2.06	2.04	2.02	1.98	1.95	1.92	1.88	1.83	1.80
Annual Net NED Benefits (Limited)		$1,777,884	$1,847,666	$1,754,194	$1,749,070	$1,732,054	$1,707,425	$1,677,177	$1,651,378	$1,614,929	$1,573,904	$1,536,756
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$2,088,481	$2,397,172	$2,685,026	$2,992,604	$3,289,595	$3,550,112	$3,761,296	$3,935,366	$4,099,621	$4,239,088	$4,358,509
Total SDR & Recreation Benefits - Unlimited		$3,764,937	$4,090,996	$4,389,846	$4,704,524	$5,006,666	$5,271,494	$5,486,131	$5,662,794	$5,829,378	$5,969,668	$6,091,086
Annual Net NED Benefits - Unlimited		$2,189,909	$2,551,014	$2,734,400	$3,029,753	$3,304,578	$3,536,155	$3,713,639	$3,859,316	$3,984,793	$4,082,413	$4,162,688
B/C Ratio - SDR & Recreation - Unlimited		2.39	2.66	2.65	2.81	2.94	3.04	3.10	3.14	3.16	3.16	3.16

4.8.3 The NED Plan Components

Table **4-6** highlights the NED Plan Components.

Table 4-6 – NED Plan Components

Alongshore Length (meters)	1,040
Berm Width (meters)	15
Berm Crest Elevation (meters, MLLW)	+5.2
Foreshore Slope at Equilibrium	8H:1V
Renourishment Interval	6 years
Volume, m^3 (yd^3)	192,000 (251,000)

4.9 The Four Accounts

The Planning Principles and Guidelines (P&Gs) which replaced the 1972 "Principles and Standards," directs the studies of major water projects by Federal water resources development agencies. A stated purpose of the P&Gs is to ensure that the formulation and evaluation of water resource studies are done properly and consistently by federal agencies. The federal objective in project planning is to contribute to national economic development (NED) while protecting the environment. NED contributions are increases in the net values of national goods and services outputs, both marketed and non-marketed. A plan, consistent with federal objectives and which maximizes NED benefits, is the "NED plan."

In addition to NED, the P&Gs includes three other accounts: regional economic development (RED), environmental quality (EQ), and other social effects (OSE). Collectively, the four accounts are required to include all significant effects of a plan on the human environment. The RED account includes the regional incidence of NED effects, income transfers, and employment effects. The EQ account shows the non-quantifiable effects of a plan on ecological, cultural, and aesthetic attributes of significant natural and cultural resources. The OSE account displays the effects of a plan on urban and community settings and on life, health, and safety.

The P&Gs require only that the NED account be developed for the selection of a plan. However, information on the other three accounts, which may bear significantly on selection of a plan, should be included in the alternative assessment.

4.9.1 Regional Economic Development (RED) Account

The RED account shows the effects of plan alternatives on the distribution of regional economic activity in the area where the plan will have significant income and employment effects. All or most of the NED benefits for a plan will accrue to the region. Effects outside the study region are categorized as "rest of the United States" impacts. The effects on regional income are the sum of 1) the NED income benefits and 2) transfers from outside the region. Income transfers comprise income from implementation outlays, transfers of economic activities, and indirect and induced effects. Indirect effects are those that result from the changed outputs of goods and services in industries which help meet changes in final products and export demands. Induced effects result from changes in consumer expenditures stimulated by changes in personal income. The effects of a plan on regional employment parallel those on regional income.

Typically, employment impacts of a plan are developed for individual industries at some level of aggregation in order to discern the distributional impacts on business sectors.

Relation of the RED Account to Other Accounts

RED impacts include, principally, changes in income and employment. However, the nuances of each of those categories may easily overlap with other accounts defined within the P&Gs. As indicated above, NED impacts are also RED impacts if they occur within the region of interest. However, the NED account is to reflect all effects on the national economy and excludes indirect and induced effects because they represent inter-regional transfers of regional economic activity. Conversely, indirect and induced impacts are shown in the RED account, and differences between it and the NED accounts are therefore accounted for as transfers from or to the rest of the nation.

The RED account may also overlap with the OSE account. The OSE account includes urban and community impacts, in particular those on income, population and employment distribution, fiscal conditions, and displacement of people and businesses and farms. A flood event may have social impacts through reduced property values, contaminated drinking water, and greater exposure to biological toxins. All may have regional impacts as typically defined by the RED account, but many may not be quantifiable and thus be included in the OSE account. Others which are measurable may fit into the OSE account and concurrently be an RED impact. For example, people in flooded areas may be unable to live in their homes or commute to work. The inability to live in their homes is an OSE impact, while the inability to commute to work is also an OSE impact, but with RED implications. In the latter case, the outputs of industries will decline if employees are unable to reach their places of employment.

Study Area RED Analysis

Notwithstanding its location of an Orange County shorefront community, the San Clemente beach area provides an important public recreational resource to a growing minority and low-income population. Although the 2005 - 2007 American Community Survey by the Census Bureau reports median family income in San Clemente at $103,500, the percent of families below the poverty line has increased 34.8% since the 2000 Census. Poverty has risen from 4.6% to 6.2% for families within San Clemente. On an individual basis 8.4% of San Clemente's population of 60,355 is below the poverty line. In addition to the increase in poverty, the population of San Clemente has become more diverse. Minority population has risen from the 2000 Census level of 12.1% to 17.5% of the population.

The public beaches of San Clemente provide not only a recreational resource to the community but also a jobs and income resource. Tourism to the beaches stimulates the local economy. To measure the economic impacts of tourism the MGM2 model, an update of the NPS Money Generation Model as originally developed at Michigan State University, and more specifically the MGM2 Short form version was utilized to measure the differences in economic impacts between the without project and NED project conditions.

MGM2 Model

MGM2 estimates both the direct effects and secondary effects of visitor spending. Although economic impact analysis can be quite complex, the basic components and calculations are summarized in the following simple equation: Economic impacts = Number of Visitors * Average spending per visitor * Economic multipliers

There are three primary inputs to the Money Generation Model: Visits, Average spending Multipliers. These inputs typically come from different sources. Visits are derived from attendance use figures or an estimate of the change in visits due to some management decision to be evaluated. Spending averages are typically estimated in surveys of visitors. Multipliers are usually derived from input-output models of the region's economy (RIMS II, IMPLAN, etc.). The model includes some suggested spending averages that may be edited or replaced with local data to represent a given set of visitors. MGM2 offers several sets of multipliers that users may choose from to capture the economy in the region around the site. For the analysis of San Clemente the default MGM settings of large metro area, high spending, and multipliers were employed. The documentation of the MGM2 model describes the economic impact concepts and is described in the Economics Appendix.

Regional Economic Modeling

Many of the RED effects considered in this report are quantified using regional economic models that are based on the principles of input-output (I-O) analysis. I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within an economy (or study area). I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally-produced goods and services. The resulting mathematical formulae allow I-O models to simulate or predict the economic impacts of a change in one or several economic activities on an entire economy.

I-O analysis usees three main metrics to measure economic impacts – industry output, value added, and employment. Industry output refers to the value of goods and services produced in a region. Value added consists of four components – employee compensation, proprietor income, other property income, and indirect business tax. Labor income represents the sum of employee compensation and proprietor income. Lastly, employment is measured by the number of full- and part time jobs. For the purposes of this study, the focus is on value added, which represents regional income, and employment, which is consistent with the guidance on RED analysis presented in the P&Gs.

The primary input variable for I-O analysis is the dollar change in purchases of products or services for final use, the “final demand.” Final demand changes drive I-O models. Industries respond to meet demands directly or indirectly by supplying goods and services to industries responding directly to final demand changes. The primary output variables are predicted changes in direct, indirect, and induced economic output, employment, and income for the affected industries within a study area. Direct economic effects refer to the response of a given industry (i.e., changes in output, income, and employment) based on final demand for that industry. Indirect effects refer to changes in output, income, and employment resulting from the iterations of industries purchasing from other industries caused by the direct economic effects. Induced economic effects refer to changes in output, income, and employment caused by the expenditures associated with new household income generated by direct and indirect economic effects.

The measurement of direct, indirect, and induced linkages within a regional economy is based on the concept of a multiplier. A multiplier is a single number that quantifies the total economic effect resulting from direct effects. For example, an output multiplier of 1.7 for the “widget” production sector indicates that every $100,000 of widgets produced (the direct output of this industry) supports a total of $170,000 in business sales throughout the economy (total output of all industries), including the initial $100,000 in widget output. Several types of multipliers are produced by an I-O model, including output, employment, and income multipliers.

For this study, IMPLAN (IMpact Analysis for PLANning) is used to estimate regional economic effects of the proposed storm damage reduction improvement for San Clemente. IMPLAN is a computer-driven system of software and data commonly used to perform economic impact analysis. It was originally developed by the USDA Forest Service (USFS) to assist in land and resource management planning and has been in use since 1979. It is a widely used for economic analyses by clients in federal, state and local governments, universities, as well as the private sector. The system is now maintained and marketed by the Minnesota IMPLAN Group, Inc. (MIG), which updates the data annually, using information collected at the national, state, county, and local level.

IMPLAN is a “non-survey” or secondary I-O system, as it does not require primary, survey-based data, which is often difficult and expensive to obtain. National technical relationships among industries form the basis for the model, but are adjustable to account for unique regional conditions. Information on regional economic activity is also incorporated into the model. Changes can be made to data elements to account for regional conditions when better information, such as from primary surveys, is available.

The 2004 IMPLAN dataset was used in the analysis, and no adjustments were made to the regional data or economic model. All input values into IMPLAN were aligned to 2008 dollars employing the 2004 I/O modeling database. The RED analysis is based on a single-county model of Orange County where all impacts will occur.

Orange County Impact Area

Expenditures for this analysis occur solely within Orange County. Project implementation would support a number of federal employees, primarily Corps staff, to provide construction management and oversight services. Expenditures on construction goods, materials, and equipment that are made within the region would generate additional economic benefits as spending ripples through the local economy via inter-industry linkages. Further, labor income earned by both construction and federal workers would be re-spent, in part, in the local economy, generating additional economic activity. The regional multipliers for Orange County by industrial sector are shown in **Table 4-7**.

Table 4-7 Orange County Regional Multipliers

Multiplier	Other New Construction	Federal Non-Defense
Direct/Indirect	1.3069	1.0000
Induced	0.4889	0.6737
Total	**1.7957**	**1.6737**

As shown in **Table 4-8**, the Project is expected to generate a total of $5.6 million in output, which includes the direct value (or cost) of the Project ($3.2 million). Total value added generated by the Project in the region is estimated at $3.47 million over the construction period. Lastly, the project would generate a number of jobs both directly and in response to the Project’s demands for goods and services (i.e., indirect effects) and spending attributed to direct and indirect labor earnings (i.e., induced effects). Approximate 25 private and public jobs directly supported by the Project, an additional 20 annual jobs would be generated in the region, for a total of about 45 jobs in Orange County.

Table 4-8 Regional Economic Benefits – Orange County

Impact	Output	Value Added	Employment
Direct	$3,190,000	$2,012,000	25.1
Indirect	$850,000	$486,000	6.7
Induced	$1,594,000	$974,000	12.9
Total	$5,633,000	$3,472,000	44.8

4.9.2 Other Social Effects (OSE) Account

The Other Social Effects (OSE) account describes the potential effects of the proposed project alternatives in areas that are not dealt with explicitly in the NED and RED accounts presented above. ER 1105-2-409 states, “Any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse in the four Principles and Guidelines evaluation accounts,” of which the OSE is one. The Principles and Guidelines state that the OSE, when included in U.S. Army Corps of Engineers documents, should “display plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others.”

This particular OSE describes the potential effects of NED Plan construction. The OSE account explores the following categories of effects from the implementation of the NED plan:

- Displacement/impacts to population
- Public health and safety
- Displacement/impacts to minorities and special interest groups
- Displacement/impacts to businesses
- Displacement/impacts to agriculture
- Displacement/impacts to recreational areas
- Community growth
- Community cohesion

For the analysis of the region of influence (ROI) for direct social effects is defined as the City of San Clemente. This ROI area definition extends beyond the potential construction impact area and was chosen based on the assumption that all substantial direct social effects, if any, associated with a project of this type would be confined to this area.

Displacement/Impacts to Population

The project is expected is to be constructed during the off-season of beach activity. Its location is a non-populated public beach; however, residential and commercial locations are nearby. The direct effects of construction is not likely to result in any displacement or impacts to population beyond the health and safety concerns outlined below. Indirect construction effects are also anticipated to be minimal. It is generally assumed that the workers needed for construction would not come from the local labor pool - dredging crews of the ship coming from the ship's home port. Thus, construction-related employment is not likely to increase the population to any significant degree within the ROI.

Public Health and Safety

The analysis of effects to public health and safety includes environmental effects related to human safety, noise, air quality, and the possible effects to the populace in regard to access to emergency services.

Typically after nourishment, the foreshore slope of a beach face is steepened and extended into deeper water, creating reflected waves which can pose a potential public safety threat to swimmers and waders. In its natural, pre-nourishment condition, a beach will typically attenuate incoming waves through run-up on the naturally occurring beach slope. During the beach fill construction period and the equilibration process, it is possible that incoming waves may be reflected from the unnaturally steeper beach face. These reflected waves can compound the higher energy wave climate due to the aforementioned deeper water. Reflection can create a situation of “in and out” waves, comprised of normal waves propagating toward the shoreline colliding with the reflected waves heading out to sea. This condition of wave-reflecting, combined with a suddenly deeper drop-off at the more seaward beach face, has the potential to create hazardous swimming conditions to the recreating public. Whereas the recreating public may have become accustomed to a mild wave condition at a naturally occurring beach, it is suddenly confronted with a higher energy wave climate.

In addition, experience in some locations nationwide indicates an increase in lifeguard rescue missions immediately after a beach fill construction project. It is noted that the probability of these impacts occurring is neither guaranteed nor quantifiable, and when occurring are typically transient impacts until full profile equilibration is achieved.

Reflected waves can also potentially pose a safety issue to surfers. Reflected waves propagating seaward can pass through normal incoming waves with no effect, or can meet incoming waves and create a condition known as destructive interference. The outbound and inbound waves meet and the resulting transfer of energy can cause the waves to pitch up in a chaotic sea state, posing a potential safety risk to surfers.

Construction is likely to produce some adverse effects in regard to noise level, air quality, and near off-shore water quality levels in the construction area. Adverse noise, water and air quality effects will be most prevalent in the spaces directly surrounding the project’s features. Where these areas are close to residential areas and other sensitive land uses, direct construction-related effects to health and safety are expected. Sand placement will be accompanied by some temporary increase in noise level, increased turbulence in the near off-shore waters and some limited air quality decreases. Additionally, the project will not be relocating or displacing any emergency or health-related public services. Therefore, there are no likely construction-related direct effects to health and safety, in regard to access to emergency services.

All effects associated with noise, air quality, and water are generally localized to the areas outlined above, and construction-related indirect effects to health and safety, in regard to an increase in these dangers, are unlikely.

Increased levels of construction within the project area raise the possibility of emergency services experiencing increased activity responding to work-related injuries. Given standard construction health and safety practices, however, it is unlikely that any incremental increase in emergency services demand would be significant. Thus, there are no likely construction-related indirect effects to health and safety, in regard to access to emergency services.

Displacement/Impacts to Minorities and Special Interest Groups

As discussed above, displacements or relocations related to the construction efforts surrounding the project are unlikely. The construction footprint being on a public beach and the small workforce required for construction indicated an unlikelihood for impacts.

Displacement/Impacts to Businesses

Displacement or relocations to beach businesses are expected to be temporary and minimal. Construction will impact a limited number of beach concession businesses for a short period of time during the off-season. These impacts are considered insignificant. Given the small labor force and unaffected traffic flows the indirect impacts to businesses outside of the construction area are expected to be insignificant as well.

Displacement/Impacts to Agriculture

There are no agricultural activities in the area and no impacts are anticipated.

Displacement/Impacts to Recreational Areas

Construction will take place on a public beach during the off-season. The project will cause temporary impacts along the beach as beach fill proceeds along the beachfront. The active beach fill area will be unusable for a short period of time as sand settles and dries and adjacent areas will suffer from an increase in water turbulence. These impacts will move along the beach as the beach fill program progresses. Beach use activities will be impacted in the immediate area of current fill activity, but given the off-season construction timeframe and the overall length of the beach a significant impact is not anticipated.

Community Growth

Generally, a project is expected to promote growth if it contributes substantially to the population or economics of the area. The NED Plan is not expected to significantly contribute economically to the area during the construction phase in a direct and indirect manner. Additionally, neither plan is expected to contribute to any rise in area population, directly or indirectly, during the construction. Finally, each municipality or county controls growth in their respective areas through land use and growth policies. Other, more powerful economic considerations also directly influence area growth. Thus, plan construction is not expected to affect community growth, either directly or indirectly, during the construction.

Project Impacts and Connectivity of the Community

Connectivity is generally defined as the degree to which residents feel a sense of belonging to their neighborhood or municipality. Other important measurements include the level of commitment residents feel to the community and the level of attachment residents have to certain neighbors, groups, or institutions. Generally, these levels are higher as a result of continued association over time. Major impacts to community cohesion are generally caused by displacements to important community businesses, centers of community interactions (churches, community centers, recreation areas) or large tracts of residences. Impacts can also occur through a project separating or dividing individual communities. Finally, visual impacts can affect the quality of adjacent communities, which can sometimes affect connectivity depending on the severity of the impact.

As discussed above, construction is not expected to displace any residences, businesses, or important community areas. Some temporary recreational impacts will be experienced and potentially people may choose to travel to unaffected recreational points if construction-related disturbances are particularly annoying. However, while a small direct effect in respect to impacts to recreational areas, this minor drop in attendance is not expected to affect community connectivity directly to any significant degree. Thus, the NED Plan is not expected to directly affect connectivity during construction.

4.9.3 Environmental Quality (EQ) Account

The Environmental Quality (EQ) Account is another means of evaluating the alternatives. The EQ Account is intended to display long-term effects that the alternatives may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural and aesthetic environments, which, if affected by an alternative, could have a material bearing on the decision-making process.

The NED Plan is not expected to have great impacts on the significant environmental resources in the study area. The most significant environmental resources in the study area are the T-Street Reef, surfgrass, kelp, and lobsters. The effects of the NED Plan on the Reef and its supported resources will be minimal as the fill will only encroach on its nearshore portions and is not expected to equilibrate onto the offshore portions of the Reef or cause significant burial of the Reef. The NED Plan would have minimal effects on the surfgrass in the region as partial burial of the surfgrass in the inshore portion of the reef would likely result. The inshore portions of the Reef will experience a sand accumulation ranging from very minimal (i.e. 0%) to minimal (roughly 35%). The NED Plan is not expected to have any effect on the diverse kelp species present in the study area as its equilibrium footprint is not expected to reach or cover their habitat areas. Finally, due to the equilibration and cross-shore transport processes from the beach fill, some of the lobster habitat areas in the shallow subtidal may be negatively affected by being covered with sand. However these effects would likely be minimal as lobster habitat areas are periodically covered and uncovered by sand naturally. The beach fill from this alternative would have only minimal effects on the large kelp and reef area near the end of San Clemente Pier and other rocky habitat farther than about 150 meters (500 ft) from shore and would not degrade that habitat for lobsters.

4.10 Value Engineering Activities

ER 11-1-321 Appendix F, Section F.1, subsection 2(d) provides an example of the requirements needed for the capability of an in-house value engineering (VE) team based on an Annual VE Guidance Plan for USACE use. This section states that the "VE team must have an adequate amount of training and appropriate and sufficient experience" in the essential disciplines needed on projects, including "Architectural, Civil, Structural, Electrical, Mechanical Engineers, Cost Engineers, Environmental Scientists and other specialty consultants." The Project Delivery Team (PDT) members contributing on the San Clemente Shoreline Feasibility Study had an adequate amount of experience and training to cover this requirement.

During the feasibility phase of the study, alternatives were developed by plan formulation, coastal engineering, economics, environmental studies, cost engineering, and geotechnical engineering team members whose combined experience resulted in a sufficient level of VE analysis. The alternatives developed during the plan formulation phase of the study should be considered the result of significant planning, engineering, environmental, and economic analysis yielding highly cost-effective options for reducing shoreline damages in San Clemente, CA.

Specific examples of VE activities completed during the study include selection of borrow site, the screening of alternatives, study area refinement, and cost engineering estimation. As discussed in the Appendix E of the EIS/EIR, the borrow site offshore Oceanside, San Diego County, was chosen based on sediment compatibility with the receiving beach as well as quantity of material available. This borrow site was identified by the USACE Geotechnical Branch in 2003 as suitable for use in this study based on the aforementioned criteria. Incorporation of this criteria in borrow site selection provided a means to meet sediment compatibility requirements for a dredge-nourishment operation, thus minimizing future study costs. It should also be noted that beach compatible sand is the only construction material that is reasonable and environmentally acceptable to use for beach nourishment, therefore, material selection was not a factor considered for VE activities.

During the screening of alternatives, several structural alternatives were eliminated due to costs that would not be in the federal interest (discussed in Section 4.6.6). Among these alternatives were breakwaters and groins. Breakwaters and groins were both eliminated during initial screening of alternatives as they would demand extremely high costs, potential environmental impacts and severe public opposition. Initial screening of these alternatives ensured that only highly-cost effective and acceptable alternatives, specifically beach nourishment, were carried into the feasibility phase for further analysis.

In addition to the screening of alternatives, the refinement of the study area (Section 2.1 “Reach Selection Criteria”) contributed to the VE efforts within the plan formulation phase of the study as several reaches were excluded from further analysis due to lack of potential NED benefits. For example, Reaches 2, 4, and 8 were eliminated from further study because their average beach width ranges from 15 to 19 meters (50 - 63 feet) wide, and the lack of ocean side development suggests NED benefits in these reaches would be primarily recreational. This realization allowed further time and analysis be spent on Reach 6, an unprotected 1,040 meter (3,412 foot) stretch of beach that would likely yield the greatest NED benefits and potential for project justification later in the feasibility study.

Finally, the cost estimation performed in the study provided the most accurate estimate of what the project would actually cost based on the methods of calculation. The software program used, The Cost Engineering Dredge Estimating Program (CEDEP), employs the best available methods for cost estimation on a USACE project. CEDEP meets the requirements for preparing estimates in lieu of using the Micro-Computer Aided Cost Engineering System (MCACES) software program.

4.11 The Environmentally Preferred Alternative

The National Economic Development (NED) Plan account identifies beneficial and adverse effects on the nation’s economy. Beneficial effects are increases in the economic value of the national output of goods and services from a plan. Adverse effects are the opportunity cost and resources used in implementing a plan. The “NED Plan” is the plan that maximizes the economic benefits to the nation. An array of beach nourishment alternatives ranging from 10 m (33 ft) to 60 m (198 ft) widths were analyzed to determine the plan with the maximum NED benefits. The 15 m (50 ft) Beach Width Alternative has been identified as the NED plan.

The Environmentally Preferred Alternative is the alternative that has the least negative impact on environmental resources in the study area. The 15 m (50 ft) Beach Width Alternative, in addition to being the NED Plan, is identified as the Environmentally Preferred Alternative.

4.11.1 Alternatives Evaluation to Determine the Environmentally Preferred Plan

During the course of evaluating each of the alternatives, it was discovered that there is a potential for environmental impacts to varying degrees with the various alternatives. While the 15 meter plan has been identified as the National Economic Development (NED) Plan, the planning process requires that the recommended plan meets both the prescribed criteria as well as not violating the constraints identified for this study.

During the analysis of the alternatives, the estimated equilibrated profile at the T-Street Reef was used to determine the potential impacts each alternative would have to both the surfgrass as well as surfing. The estimation for toe of fill and resultant rock coverage was based on the profile translation method. The profile translation method was deemed better able to represent potential habitat burial impacts over a rigorous volumetric analysis.

In southern California typical depth of closure ranges between 8-15 m (26-50 ft) water depth. This range is applicable for beaches that have a full sand shoreface and are able to exchange sand cross-shore unrestricted. Recent repetitive profile surveys conducted at T Street indicate that the depth of closure is -4.9 m (-16 ft). This corresponds to the middle portion of the offshore reef. The repetitive surveys suggest that all sand material on the beach is trapped between the foreshore and the offshore reef. Seaward of the reef is bedrock and the repetitive profiles indicate no changes.

The toe of fill in the present analysis was placed at 8 m (26 ft) depth. This toe of fill depth was chosen to represent possible extreme cross-shore transport mechanisms (i.e. severe storm). The toe of fill delineation was not volumetrically balanced with the fill volume. The profile translation method results in a very conservative estimate which translates to a conservative estimate of bottom coverage and possible habitat impacts. This decision was deliberate reasoning that a conservatively large estimate (as opposed to an aggressively small estimate) was appropriate to highlight the potential impacts to bottom habitat. This analysis is presented below.

Alternative 2 – 15 meters

Surfing: The equilibration footprint of a 15 m beach fill (shown in **Figure 4-7**) is less likely to significantly modify the refractive abilities of the most seaward extent of the reef. This alternative could potentially have impacts to the surf zone region between shoreline and the take off zone. The surfing experience might consist of a normal take-off after which leads to a (shorter) “close-out” as the wave encounters the straightened bathymetric contours.

Surfgrass: Partial burial of the surfgrass in the inshore portion of the reef would likely result. The equilibrium cross-section profile of the 15 m beach width alternative suggests that the inshore portions of T-Street reef will experience a sand accumulation of about 0.5 m (1.7 ft). Surfgrass in this area grows on 0.3 to 0.6 m (1 to 2 ft) boulders and has average blade lengths of 0.6 to 1 m (2 to 3 ft). Therefore, the equilibrium footprint of the 15 m alternative likely would result in a range of impacts between no burial of surfgrass on the larger rocks and up to 0.2 m (0.7 ft) of burial of surfgrass on the smaller 0.3m (1 ft) boulders. Some of the surfgrass in the shallower area, thus, would experience burial of between about 25 and

35 percent of its blade length. Burial of surfgrass on the outer portions of T-street reef would be minimal. Surfgrass is adapted to partial sand burial, routinely survives seasonal sand burial of part of its blades, and can recover quickly via regrowth if the root system is intact; however, the degree of sand burial surfgrass can withstand is not well documented . Some of the surfgrass in the deepest portion of T-Street reef has 2/3 of its blades covered with sand, which suggests that surfgrass could withstand temporary burial of up to 2/3 of its blade length. A recent laboratory study of *Phyllospadix scouoleri* suggested that short term sand burial may result in shoot mortality, decreased shoot counts, and reduced growth of surfgrass. The study found that shoot density decreased compared to controls for a burial depth of 25 cm (0.8 ft), but not shallower burial depths. Mean shoot growth rate decreased in all burial treatments. Therefore, the 15 m Beach Width Alternative may result in some degradation of the shallower portion of the surfgrass habitat, but would not result in a substantial loss of surfgrass. For the 15 m alternative, the sand from the beach fill is predicted to move out of the equilibrium footprint within four years. The continuing renourishments are not expected to have differing impacts on surfgrass from the initial nourishment.

<u>Kelp Beds:</u> High-value reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp, and sparse surfgrass is located approximately 300 to 400 m (1,000 to 1,300 ft) from shore. Little or none of the fill from the 15 m alternative is expected to reach this area.

<u>Lobsters:</u> In addition to partial burial of surfgrass, offshore movement of sediment may result in filling in some holes and crevices in the shallow subtidal that are used by lobsters. These shallow subtidal reef areas are periodically covered and uncovered by sand naturally (i.e., in the absence of a beach nourishment project). The beach fill from this alternative would have only minimal effects on the large kelp and reef area near the end of San Clemente Pier and other rocky habitat farther than about 150 meters (500 ft) from shore and would not degrade that habitat for lobsters.

<u>Resource Agencies:</u> NOAA Fisheries (NMFS) has some concerns about this alternative because of the potential surfgrass impacts, but the Fish and Wildlife Service (FWS) and CA Department of Fish and Game (CFG) seemed to be in concert with this alternative. Nonetheless, the FWS is developing and composing the mandated Fish and Wildlife Coordination Act Report (CAR). The FWS will use information and concerns from NMFS and CDFG in developing their consensus CAR. In addition, as stated in Section 5.4.2 of the EIS, the NED Plan is not expected to have significant impacts on Essential Fish Habitat in Reach 6.

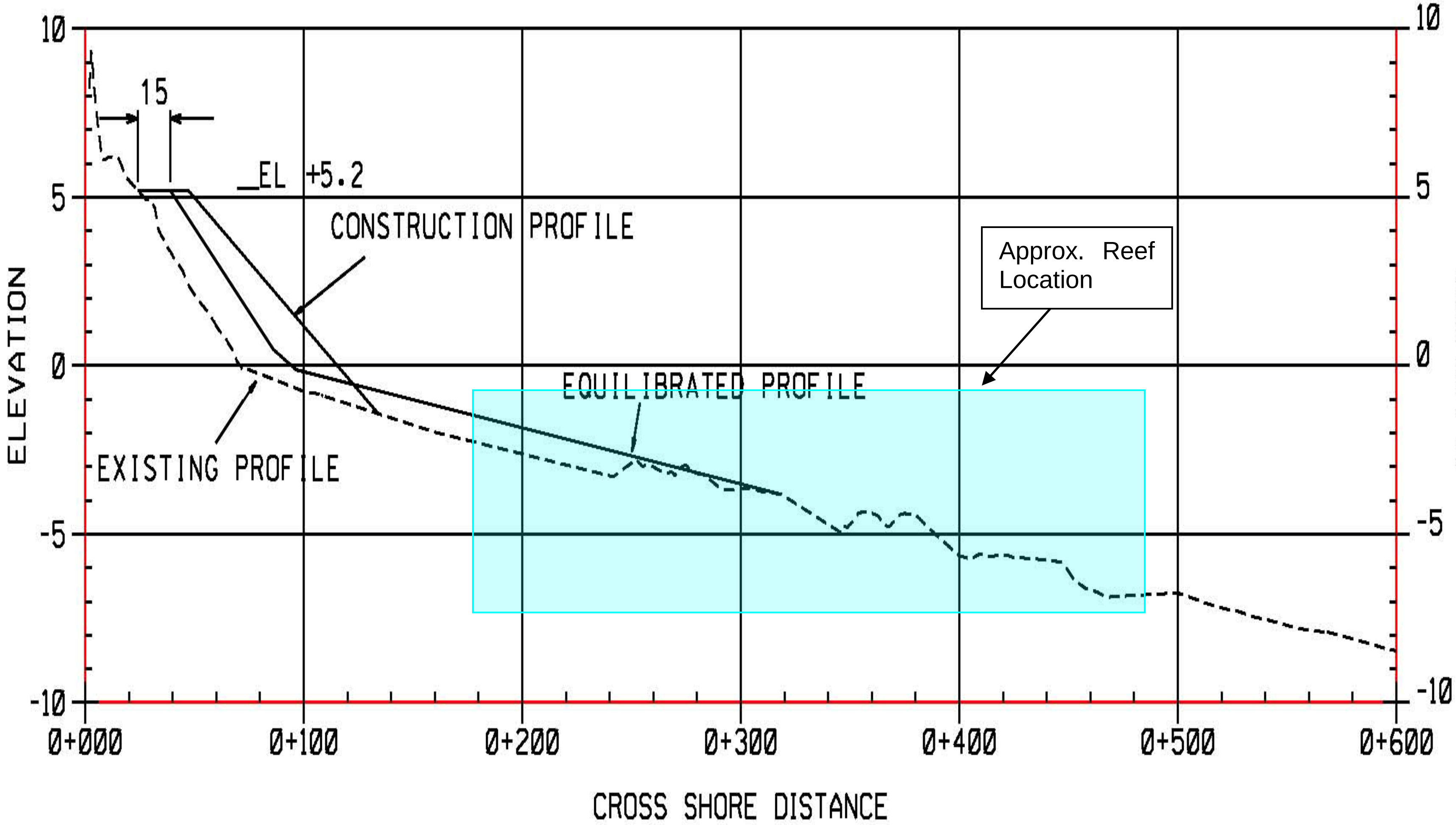


Figure 4-7 15 m Alternative

Alternative 3 – 20 meters

Surfing: Impacts would potentially be greater than the 15 m alternative, with both takeoff and close out potentially being affected, thus causing an abrupt "take off" and a much shorter "close out" and reducing the effects on wave formation. .

Surfgrass: Based on the cross section profile, the 20 meter alternative (see **Figure 4-8**) would result in sand cover over most of the T-Street Reef. The predicted depth of burial of the inshore portions of the reef would be about 1 m (3 ft). Surfgrass growing on the 0.3 to 0.6 m (1 to 2 ft) boulders in this area would have their blades covered by 0.3 to 1.2 m (1 to 4 ft) of sand. Some surfgrass growing on the smaller 0.3 m (1 ft) boulders would be buried completely. Surfgrass with 1 meter (3 ft) blades on 0.6 m (2 ft) boulders would only have about 1/3 to 1/2 of their blades buried. On the offshore portions of the reef burial would range from about 0.2 to 0.8 m (0.8 to 2.7 ft) with most of the burial between about 0.5 to 0.6 m (1.5 to 2 ft). Surfgrass on the 0.3 m (1 ft) boulders that are typical of offshore would have between 0 and 93 percent of their blade lengths covered by sand. Because some of surfgrass on the offshore edge of the reef already has up to 2/3 of its blade length buried, some surfgrass at the offshore edge of the reef would be completely buried. Therefore, the 20 meter alternative would be expected to result in some effects on all of the surfgrass habitat on T-Street Reef and complete loss of some of the surfgrass throughout the reef.

Kelp: Approximately 20 percent of the offshore reef that supports kelp and other sensitive resources would be within the equilibrium footprint of the 20 m alternative. The increase in sediment thickness on the affected portion of the offshore reef would be expected to range from less than 0.3 to 1 m (1 to 3 ft). The portions of the reef affected by sediment transport might not support kelp recruitment and sea fans, which are sensitive to sedimentation, may be killed. Holes and crevices used by fishes, crabs, and lobsters may be filled with sediment.

Lobster: Much of the reef habitat used by lobster out to about the depth of the end of the Pier may be affected by sedimentation. Holes and crevices in the rocks that lobster use for shelter may become filled with sand with some degradation of habitat.

Resource Agencies: The FWS' CAR could have a negative slant to its conclusion for this alternative for surfgrass and other marine resources that will be affected, such as the micro and macro benthic invertebrates as well as effects to essential fish habitat. FWS could conclude that the 20 meter alternative is not the least damaging alternative.

The Corps will develop and submit, under the California Coastal Commission's Federal Consistency Program, a Coastal Consistency Determination (CCD) to the California Coastal Commission (CCC) staff, which may result in a negative staff report to the CCC Commissioners. Much will depend on how surfing is affected under the Coastal Act's Section 30220 Protection of certain water-oriented activities as well as Sections 30230, 30231, 30233(d).

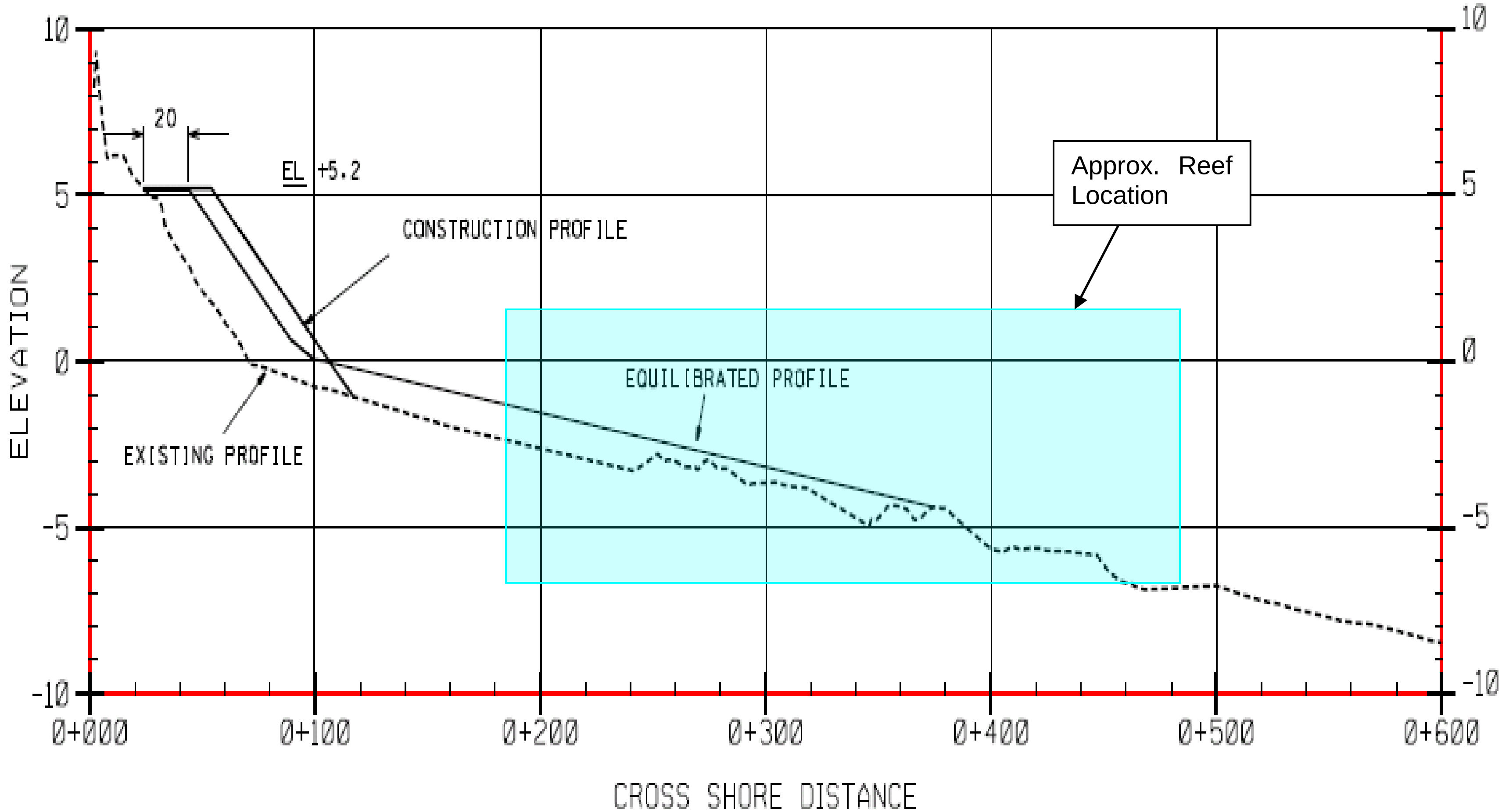


Figure 4-8 20 m Alternative

Alternative 4 – 25 meters

Surfing: Impacts would potentially be greater than the 15 m alternative, with both takeoff and close out potentially being affected.

Surfgrass: The impacts to surfgrass on T-street Reef for the 25 meter alternative (see **Figure 4-9**) would be similar to the impacts of the 20 m alternative.

Kelp: The equilibrium footprint of the 25 m alternative would affect about 40 percent of the reef and kelp bed offshore of San Clemente Pier. Sediment cover may retard kelp recruitment on the affected portion of the reef. Sea fans may suffer negative impacts from sedimentation. Holes used by lobsters, crabs, fishes, and other animals may become filled with sediment.

Lobster: The 25 m alternative will affect rocky habitat used by lobster out to about 366 meters (1200 ft) from shore.

Resource Agencies: Same as above for 20 meter, but a greater probability (<95%) of receiving a negative staff report to the CCC Commissioners.

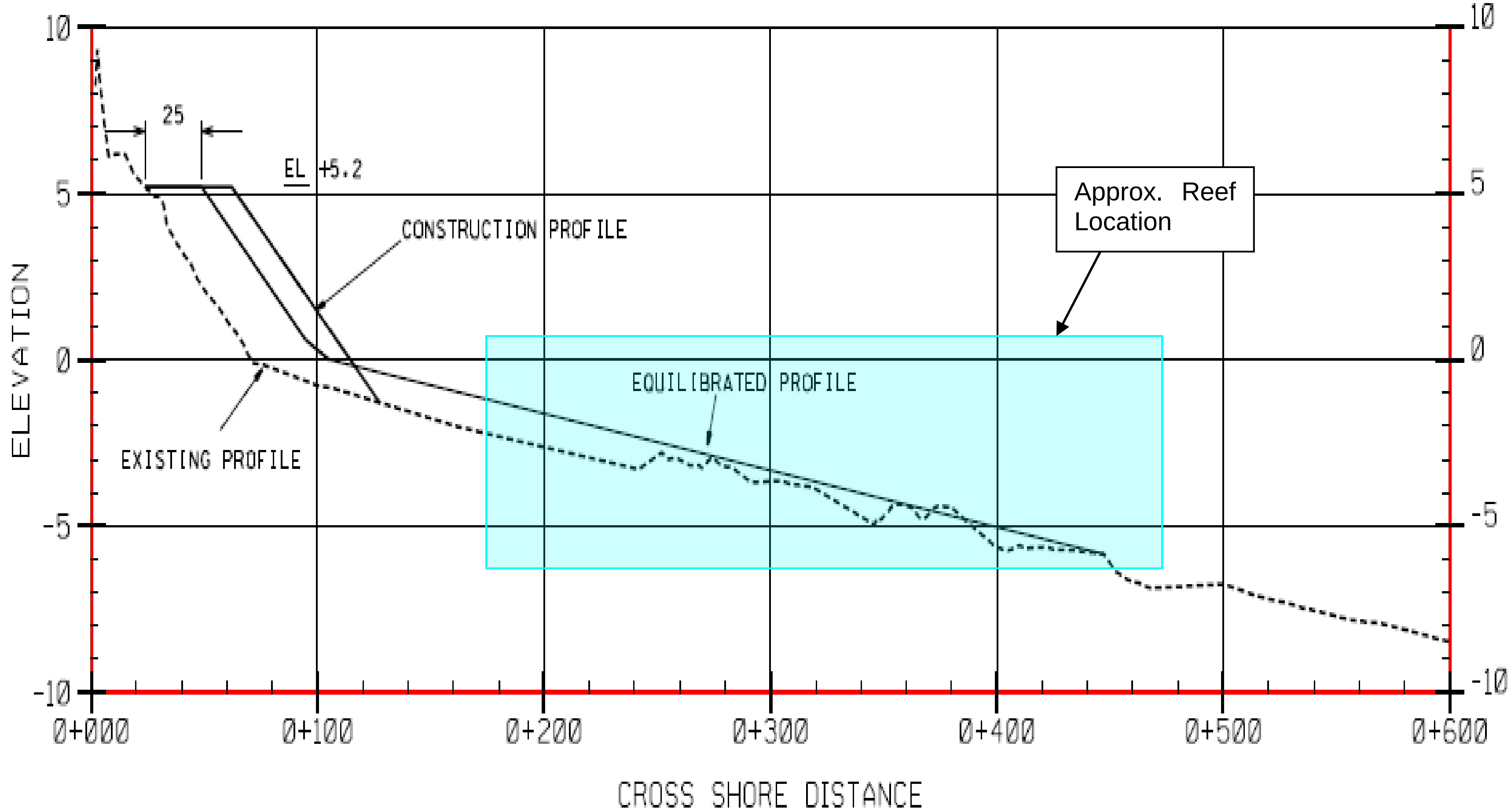


Figure 4-9 25 m Alternative

Alternative 5 – 30 meters

Surfing: Impacts would potentially be greater than the 15 m alternative, with both takeoff and close out potentially being affected.

Surfgrass: Impacts of the 30 m alternative (see **Figure 4-10**) to the surfgrass on T-street reef would be similar to the 20 and 25 m alternatives. The entire reef would be affected by sedimentation resulting in degradation of the entire habitat.

Kelp: The equilibrium footprint of the 30 m alternative would result in sedimentation of about 60 percent of the reef off San Clemente Pier. Sediment cover may retard kelp recruitment on the affected portion of the reef. Sea fans may suffer negative impacts from sedimentation. Holes used by lobsters, crabs, fishes, and other animals may become filled with sediment.

Lobster: The 30 m alternative will affect rocky habitat used by lobster out to about 457 meters (1500 ft) from shore.

Resource Agencies: Same as above for 20 meter, but a greater probability (<95%) of receiving a ***denial*** report to the CCC Commissioners.

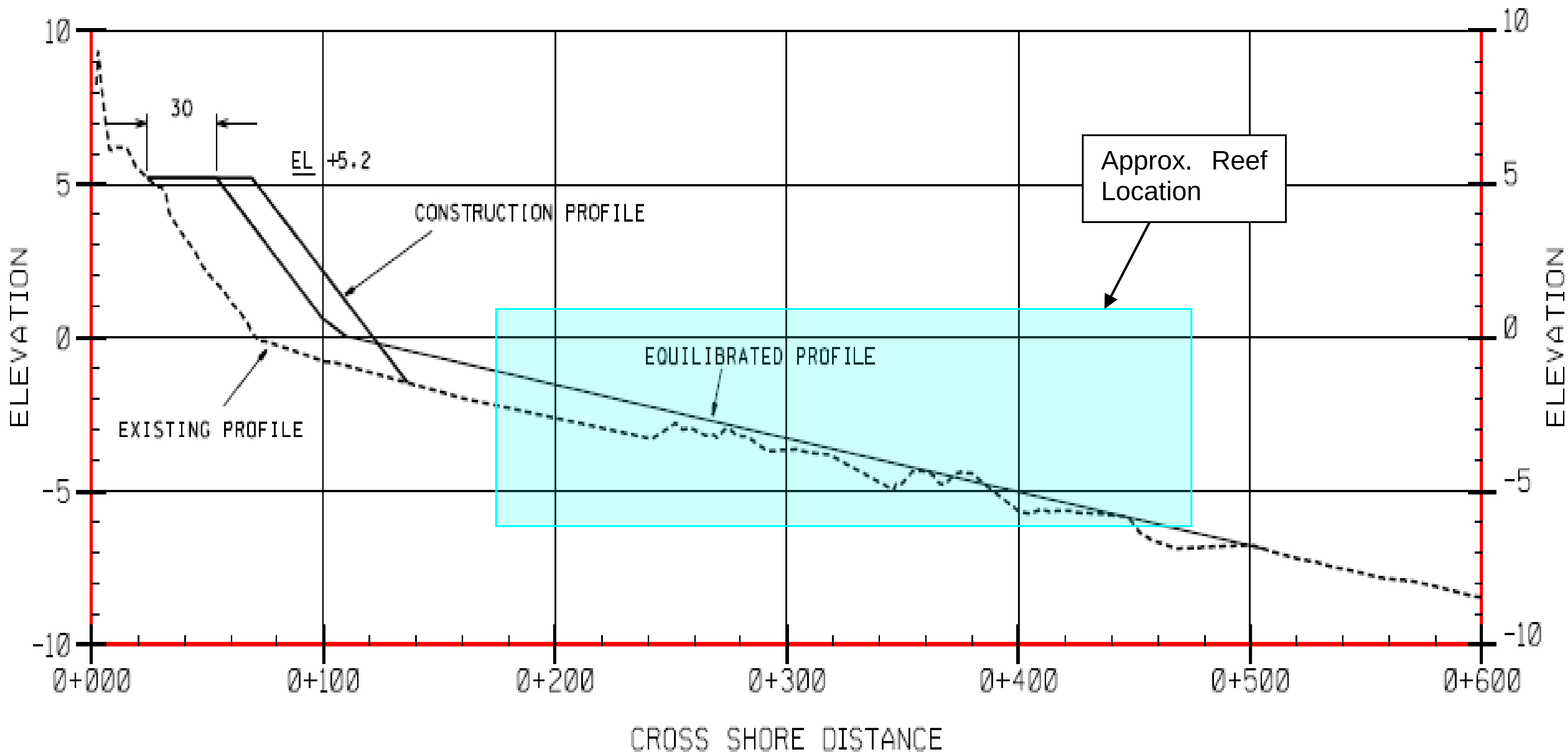


Figure 4-10 30 m Alternative

Alternative 6 – 35 meters

Surfing: The final equilibrium profile of this alternative is shown in **Figure 4-11**. Since the surfing area extends from the existing shoreline to approximately 200 m seaward, this creates an immediate potential for impacts to the surfing area. As sand is introduced into the reef system, the characteristic reef shape could be modified and/or lost as it becomes covered by a sand bar. The refractive abilities of the reef may be modified or lost, lessening the focusing effect of the reef and thereby erasing the "point break" characteristics of T-Street. As the reef continues to fill in with sand, the overall bathymetry of the area may begin to become straight and parallel and the wave will lose its ability to "feel" the reef. The wave may begin to exhibit more spilling characteristics normally associated with beach breaks. This also has the potential to modify the consolidated "take-off" zone and be replaced by a more disorganized situation containing many "take off" zones with shorter, more varied break directions. The straightening contours may also cause the wave to tend to break all at once, termed a "close-out" condition. Further flattening of the slope in the reef area due to sand introduction into the reef system ultimately has the potential to change the characteristic plunging point break to a quasi- spilling beach break

Surfgrass: Impacts of the 35 meter alternative on T-street reef would be similar to the impacts of the 20, 25 and 30 meter alternatives because the entire reef would be affected by sedimentation. The shallow portions of the reef may be buried by over a meter of sand (about 3 ft). This level of sedimentation would result in at least partial burial of all of the shallow surfgrass in the inshore portions of the reef. Surfgrass on the smaller boulders would be completely buried, and surfgrass on the larger boulders would have ½ to 2/3 of their blade length buried. On the offshore portions of the reef, burial impacts would be expected to range from about 0.3 m (1 ft) to 0.8 m (2.7 ft). Because some of the surfgrass at the offshore edge of the reef already has up to 2/3 of its blade length buried, some surfgrass at the offshore edge of the reef may be completely buried. Therefore, the 35 m alternative has the potential to result in substantial burial of surfgrass with likely significant adverse impacts on the surfgrass habitat.

Kelp: The 35 m alternative would result in sedimentation of considerable reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp and sparse surfgrass. Sediment from the 35 m alternative would affect about 70 percent of the offshore reef. The increase in sediment thickness in this reef habitat may be as much as 1 m (3.3 ft) in places. The burial of up to a meter of reef habitat may include some of the smaller rocks and prevent the recruitment of kelp. The sedimentation also may kill gorgonians and fill in crevices used by lobster. The 35 m alternative, thus, has the potential to result in substantial degradation of high-value nearshore reef habitat.

Lobster: The 35 m alternative would affect a greater amount of rocky habitat used by lobster than any of the other alternatives. The majority of rock patches and reefs in the project area would experience sedimentation effects from this alternative.

Resource Agencies: Same as above for 20 meter, but ***denial*** from staff report to the CCC Commissioners.

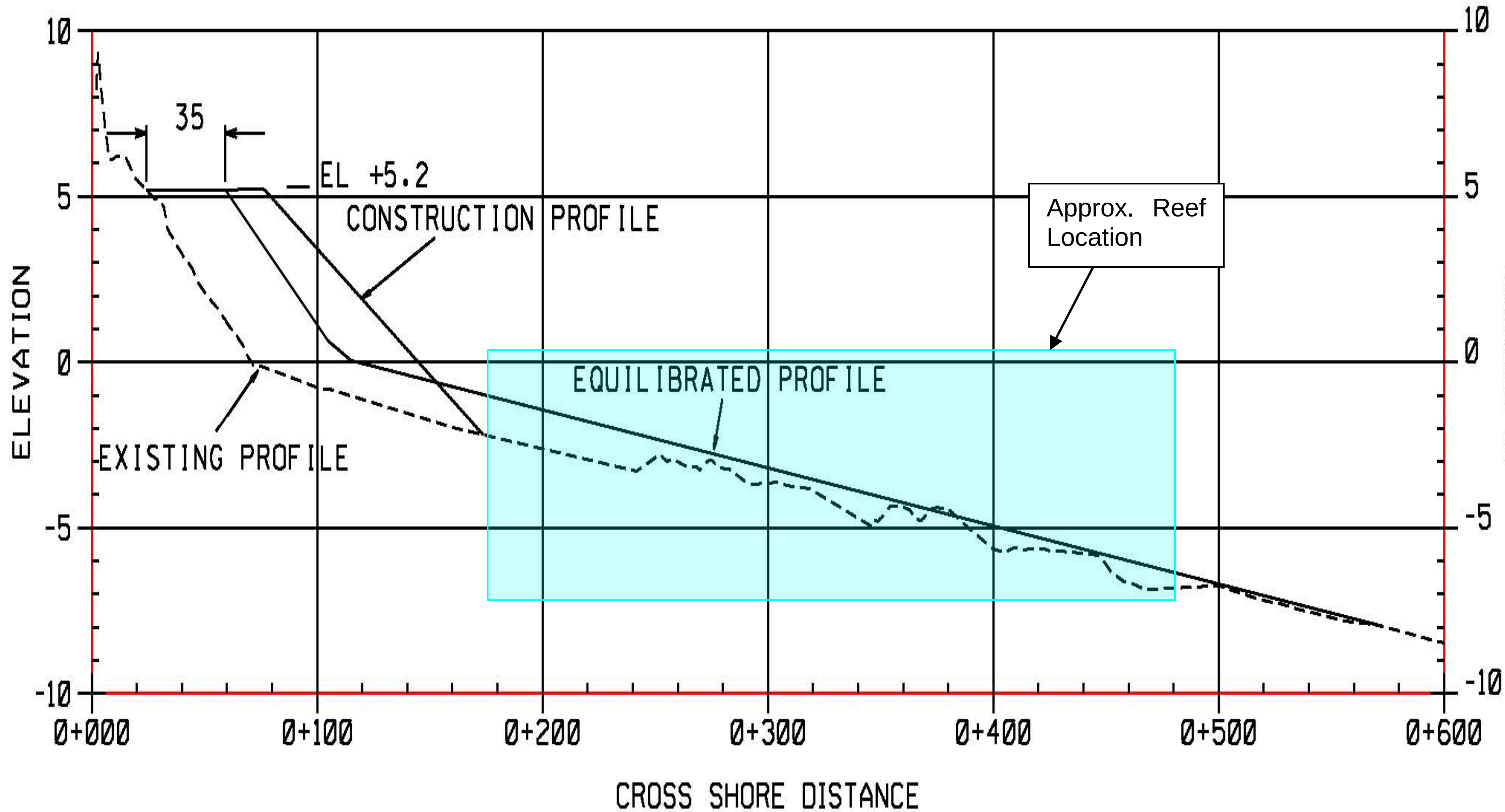


Figure 4-11 35 m Alternative

4.11.2 The Environmentally Preferred Plan: 15 m (50 ft) Beach Width Alternative

For the reasons described in the section above, it was concluded that the 15 m Beach Fill Alternative is the Environmentally Preferred Plan.

4.12 Summary of Potential Environmental Consequences for the NED Plan

The sand placement footprint for the NED plan does not include any kelp beds, surfgrass, or rocky intertidal areas, therefore, no direct impacts to sensitive habitats would occur from the placement of sand on the beach.

Following initial placement, a portion of the sand may move upcoast, downcoast, and offshore depending on the magnitude, direction, and period of waves. The nearest significant rocky intertidal area to the proposed beach fill location is at Mariposa Point, approximately 485 m (1,600 ft) north of the northern end of the beach fill site at Linda Lane. The net movement of beach sands in the Project area is expected to be southerly, but some northerly movement may occasionally occur. Based on monitoring of the SANDAG beach fill project at Oceanside, most sand movement is expected to be toward the south (USACE 2009). Therefore, it is unlikely that significant quantities of sand will be transported to the north to the rocky intertidal habitat at Mariposa Point. The equilibrium footprint for the 15 m (50 ft) Beach Width Alternative indicates that sand will not extend as far upcoast as Mariposa Point.

In addition, the proposed alternative would not place anchors for the mono buoy, where the hopper dredge will moor while it discharges sand to the beach, or place the sinker pipeline that will pump the sediment to shore from the hopper dredge on any sensitive habitat. The construction contractor shall avoid placement of anchors or the submerged pipeline onto reef habitat, which could crush attached organisms. The construction contractor shall also avoid side to side movement of the anchors or pipeline as they are placed, which could abrade surfgrass, algae, or attached invertebrates. If a substantial amount of surfgrass or kelp were affected by placement and removal of anchors and pipelines, the impact would be considered significant. These impacts would be avoided and minimized by performing a pre-construction survey to identify anchor and pipeline locations that would avoid sensitive resources. Because most of the surfgrass in the Project area grows on T-Street reef, it is possible to avoid surfgrass by avoiding the reef when laying the pipeline. In addition, to avoid impacts to reefs that support kelp and other sensitive species such as gorgonians and surfgrass, the hopper dredge should moor inshore of these reefs, which are located approximately 350 to 400 m (1,200 to 1,300 ft) from the beach.

4.12.1 Potential Impacts

Habitat Impacts

The 15 m (50 ft) beach width alternative would use the dredged sand to widen approximately 1,040 m (3,412 ft) of San Clemente Beach coastline. The immediate post-construction width of the beach would be approximately 23 m (76 ft), but through winnowing and adjustment the eventual beach width would be about 15 m (50 ft). The construction footprint for this alternative would be approximately 113,242 m^2 (28 acres (ac)). The equilibrium footprint, resulting from some of the placed sand moving offshore, would be approximately 499,286 m^2 (124 ac).

The proposed fill would be expected to have varying levels of burial impacts due to seasonal cross-shore movement of sediment (Appendix D of the EIS/EIR). During the summer months, the equilibrium profile is expected to be biased towards the shoreline. During the summer, when lower wave energy conditions are prevalent, sediment typically migrates across the profile from deeper water to shallower water, resulting in a net accumulation of sediment in the foreshore. During the winter months, the equilibrium profile would be biased toward the offshore bar. Higher energy winter wave conditions cause sediment to move across the profile from shallower water to deeper water, resulting in a net gain of sediment towards the offshore tail of the profile.

The beach fill proposed for San Clemente would be expected to perform in a manner consistent with other recent beach fills. **Figure 4-12** shows the profile for a recent fill by SANDAG of 319,960 m^3 (421,000 cy) along 1,321 m (4,400 ft) of beach at Oceanside. This profile shows a movement of up to 2 m (6 ft) of thickness across the profile. In general, beyond about 0 MLLW, the post beach fill profiles were within the range observed prior to the beachfill. **Figure 4-7** shows the cross sectional distribution of this sediment for the 15 m (50 ft) Beach Width Alternative.

These temporary burial impacts in the nearshore area could result in temporary adverse effects, including partial burial of T-Street reef. Although these effects would be adverse, because they would be short-term and only would occur in the inshore portions of the reef, they would not result in a substantial adverse modification of nearshore topography.

Surfing Impacts

Some of the sand placed on the beach for the 15 m (50 ft) Beach Width Alternative would move offshore. At T-Street reef, most of this sand would accumulate in the shallower portions of the reef. The potential effects on the nearshore wave dynamics could be considered adverse depending on the consideration (e.g., surfing or sand transport). The sand from the 15 m (50 ft) Beach Width Alternative would persist for up to four years, however, the level of burial is expected to steadily decrease during this time at about a 4 m (13 ft) loss per year erosion rate. Therefore, the impacts to wave characteristics, although potentially adverse, would be relatively short-term and less than significant.

The impacts on surfing quality from this sand movement are not rigorously quantifiable. Because the equilibrium footprint would not extend into the offshore portions of the reef, it would not be likely to significantly modify the refractive abilities of the most seaward extent of the reef. However, the 15 m (50 ft) Beach Width Alternative may have impacts to the surf zone region between the shoreline and the “take-off” zone, or the area where surfers start their ride as the surfboard is propelled by the wave. The surfing experience might consist of a normal “take-off,” but then “close-out” as the wave encounters the straightened bathymetric contours inshore (USACE 2009); a “close-out” condition is when a wave breaks along its entire length at once. Although impacts due to the wider beach may occur, historic aerial photographs of San Clemente Beach at the Pier indicate that the beach width in 1990 was approximately 17 m (55 ft) wide and no records have been found that indicate surfing ceased within the Project area during that time.

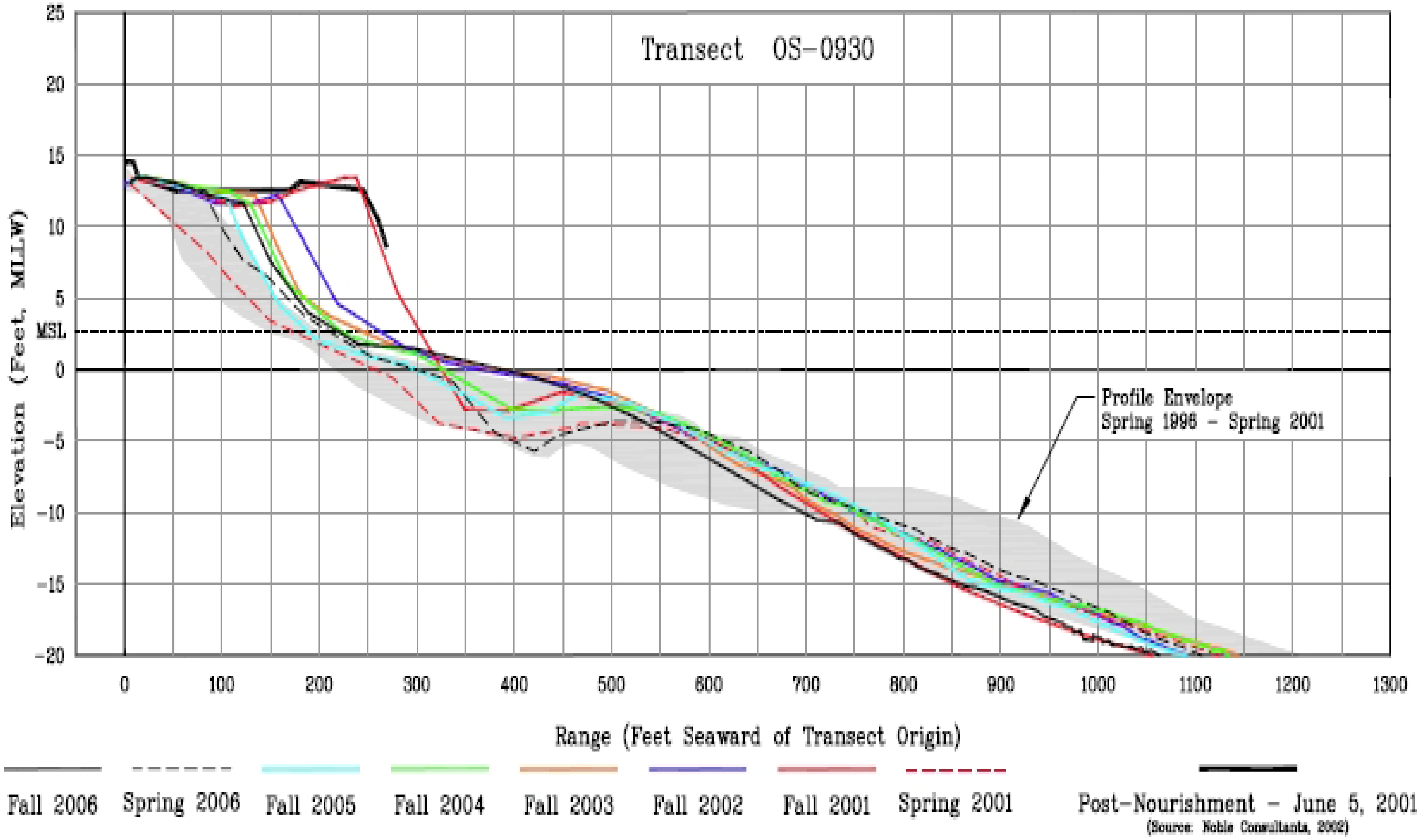


Figure 4-12 SANDAG Oceanside Beach Fill Profiles (Before and After Construction)

5 RECOMMENDED PLAN

5.1 General

The NED Plan is the plan that has a benefit-to-cost ratio greater than one and produces the greatest net benefits. The alternatives, with limited recreational benefits, range from 1.48 to 1.88 and $914,469 to $1,299,188 for B/C ratios and average annual net benefit, respectively, for the base sea level case. The Alternatives range from 1.80 to 2.20 and $1,536,756 to $1,847,666 for B/C ratios and average annual net benefit respectively for the max sea level case. Based on the model optimization and analysis of the costs and benefits outlined above and documented in the appendices, Alternative 2, the 15 m beach width has the greatest economic benefits and is the NED Plan for both the base sea level case and the max sea level case. If max sea level rise did occur during the 50 year life of the project then the NED plan could be adjusted to meet the max sea level rise case.

USACE guidance states that all plans and designs shall be evaluated to determine how sensitive they are to these various rates of future local mean sea-level rise, how this sensitivity affects calculated risk, and what design or operations and maintenance measures can be implemented to minimize this risk.

For a project such as a beach nourishment project for which the beach is typically re-nourished every 5-10 years, the local mean sea level will be reevaluated every 5-10 years (in this case every 6 years), prior to renourishment, and accommodation for sea-level rise can be made during each renourishment period.

The effects of the maximum sea-level rise case on the NED Plan are relatively minor. The number of fills over the project life increase from 9.11 to 9.66 with maximum sea-level rise. Average Annual costs show a similar slight increase from $1,429,767 to $1,539,981. Benefits do increase with the increases in without project damages. The B/C ratio increases from the base sea-level case's 1.80 to 2.20 under maximum sea-level rise. Net annual NED benefits show a similar increase from $1,384,478 to $1,693,824. These results indicate the NED Plan is manageable with monitoring and is unlikely to have a significant degree of risk under sea-level rise. Sea-level rise analysis results for each alternative are discussed in detail in Appendix D of the EIS/EIR and the Economics Appendix.

5.2 Detailed Cost Estimate for the Recommended Plan

After identification of the NED Plan using the San Clemente Economics and Engineering model, a risk-based cost analysis was performed on the recommended plan. This required analysis incorporates qualitative and quantitative cost and schedule uncertainties associated with the project to determine a project contingency and, subsequently, the fully-funded project cost. The fully-funded project cost (shown in **Table 6-5**) is used and directly referenced when requesting project Authorization and Appropriation. The detailed analysis is fully described and presented in the Cost Engineering Appendix and follows guidance laid out in ETL 1110-2-573. The Project Cost and Schedule Risk Analysis (CSRA) Report was prepared in compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

The revised project cost is approximately 38% greater than the San Clemente model's estimate. A proportional increase to the initial fill cost of the model run would raise its cost to $10.45

million. The NPV of the project construction stream would be $42 million or $2 million on an annual basis. The revised Annual NED Benefits and B/C ratio can be found in **Table 5-1**.

Table 5-1 Alternative 2 - 15 meters Revised Annual NED Benefits & B/C Ratio
(50 yr amortization at 4.125%, FY11 Price Level)

Category	W/O Project	Alternative 2	Benefits/Costs
Structural Damages - Annual			
RR Construction & O&M Costs	$1,280,000	$13,000	$1,260,000
Trail Damage	$82,000	$6,000	$75,000
Structure & Content Damage	$63,000	$16,000	$47,000
RR Delay Costs	$0	$0	$ 0
Total Damage/Reduction	$1,420,000	$36,000	$1,380,000
Recreation – Annual			
Total Recreation Value	$10,700,000	$12,300,000	$1,660,000
TOTAL ANNUAL BENEFITS			$3,040,000
ANNUAL COSTS			$2,140,000
ANNUAL NET BENEFITS (UNLIMITED)			$901,000
B/C RATIO (UNLIMITED)			1.4

5.3 Recommended Plan

The recommended plan is developed by considering the storm damage reduction and recreational potential of various beach fill configuration alternatives and optimization based on the average annual benefits and the benefit/cost ratio. Primary optimization parameters of each alternative are the dimensions of the base beach width and sacrificial beach width of the cross-sectional design profile. An array of base beach widths and sacrificial beach widths yields a matrix of Project alternatives. Based on the evaluation of potential environmental impacts, the NED Plan, the 15 m (50 ft) Beach Width Alternative, is the recommended plan since it meets the storm damage reduction needs of the study area and has the least environmental effects of the alternatives.

Figure 5-1 shows in red a schematic of the recommended plan. A cross-section of the recommended plan is shown in **Figure 5-2.** **Figures 5-3** through **5-8** are visual simulations prepared by the Non-Federal Sponsor (City of San Clemente) to help depict the NED Plan. Although the visual simulations were prepared using data from this report, the simulations should be considered approximate and not an exact representation. Importantly, the visual simulations are intended only as a visual aid to help depict what the proposed project might look like several months after initial sand placement.

Figure 5-1 Recommended Plan Alternative 2, 15 m (50 ft) Beach Width

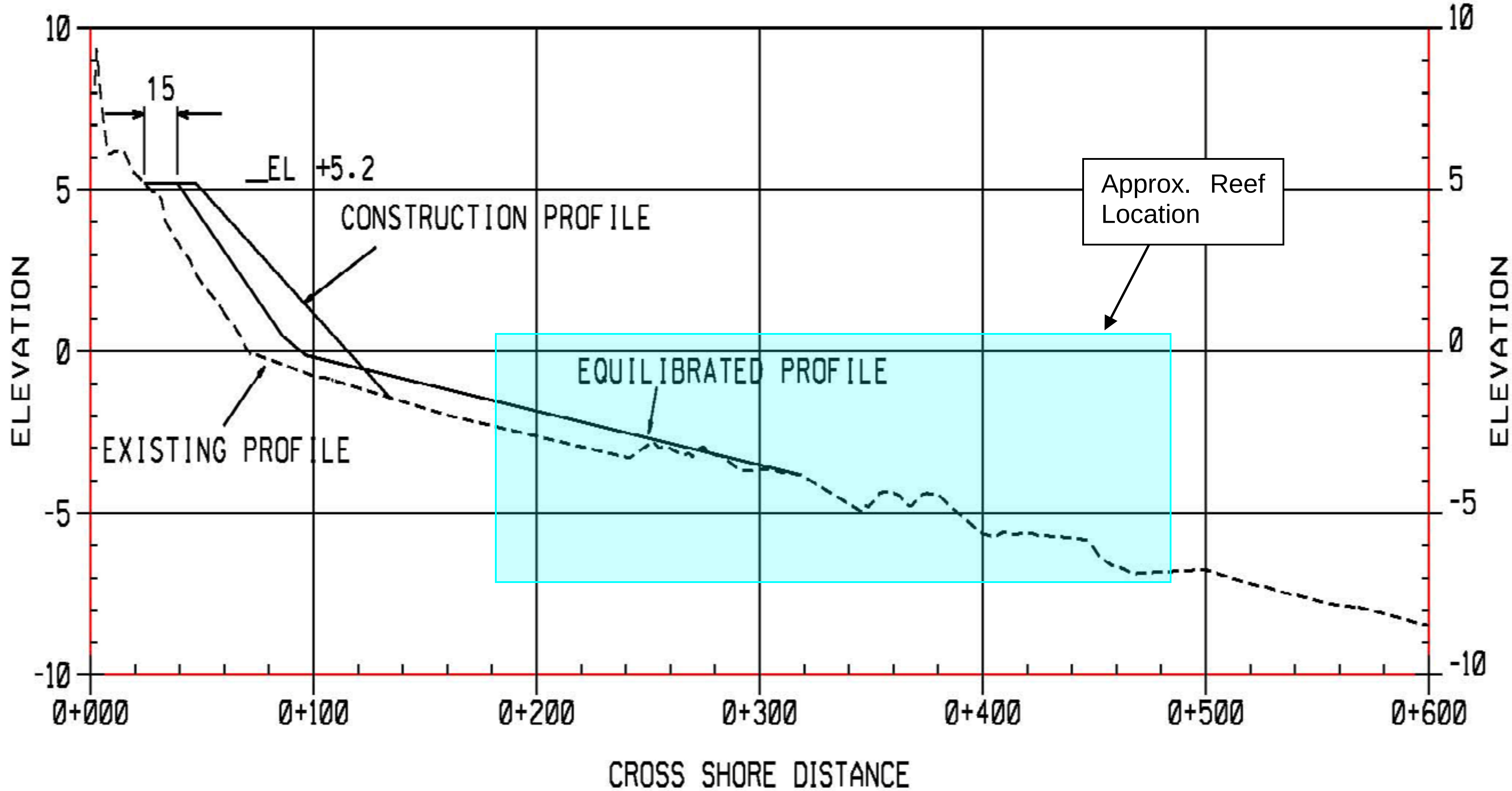
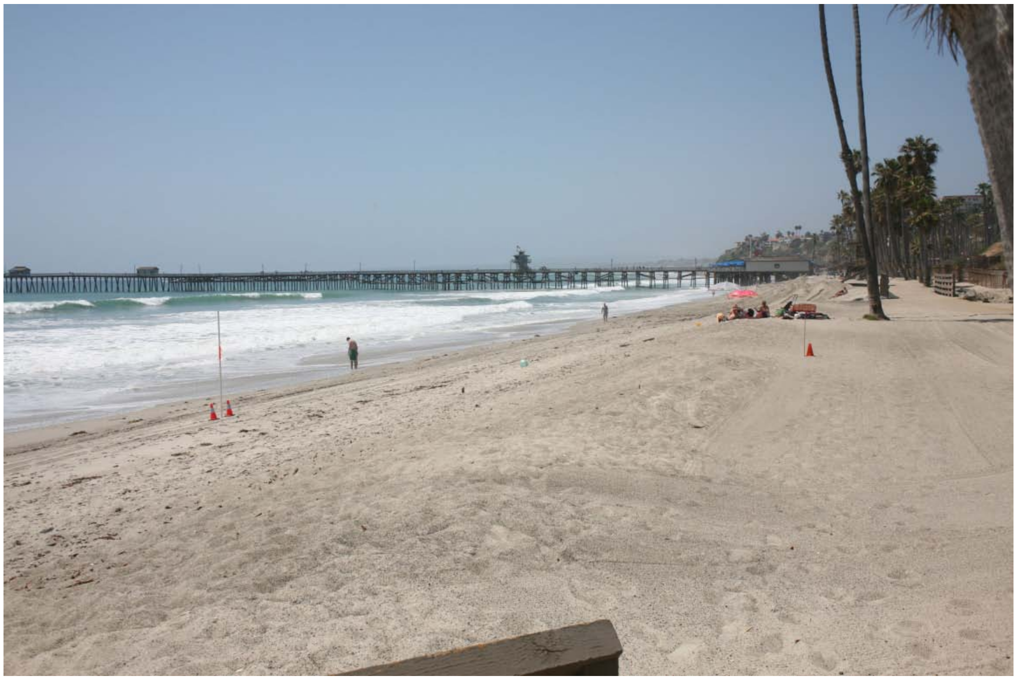


Figure 5-2 Cross Section Beach Fill of Recommended Plan

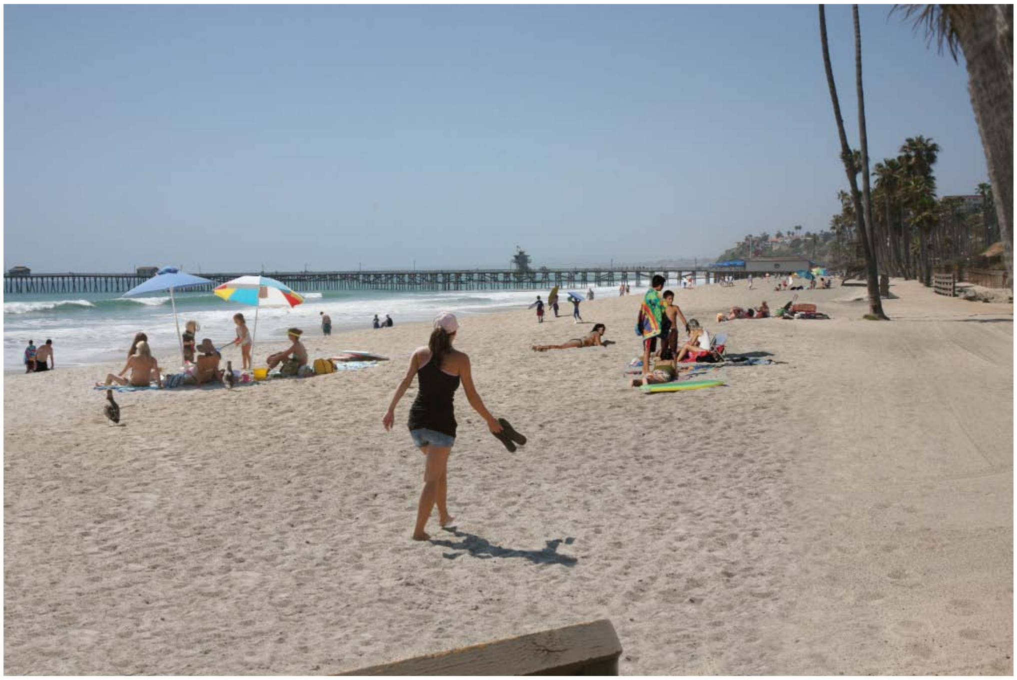
Before project

After project

Figure 5-3 View #1: From T-Street Overpass Looking North Towards the Pier

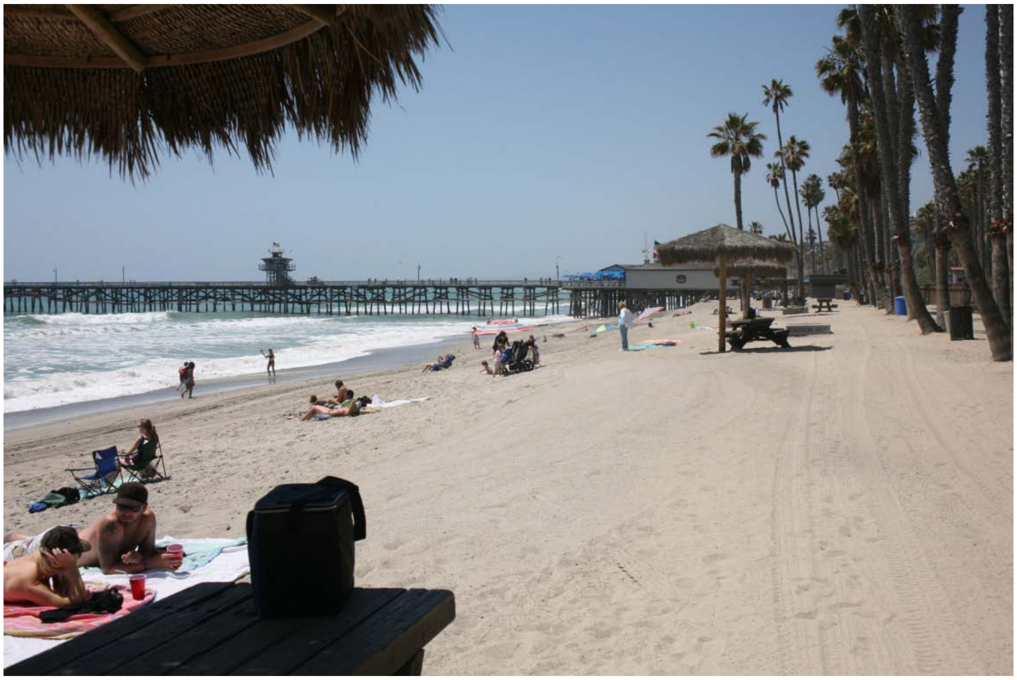


Before project

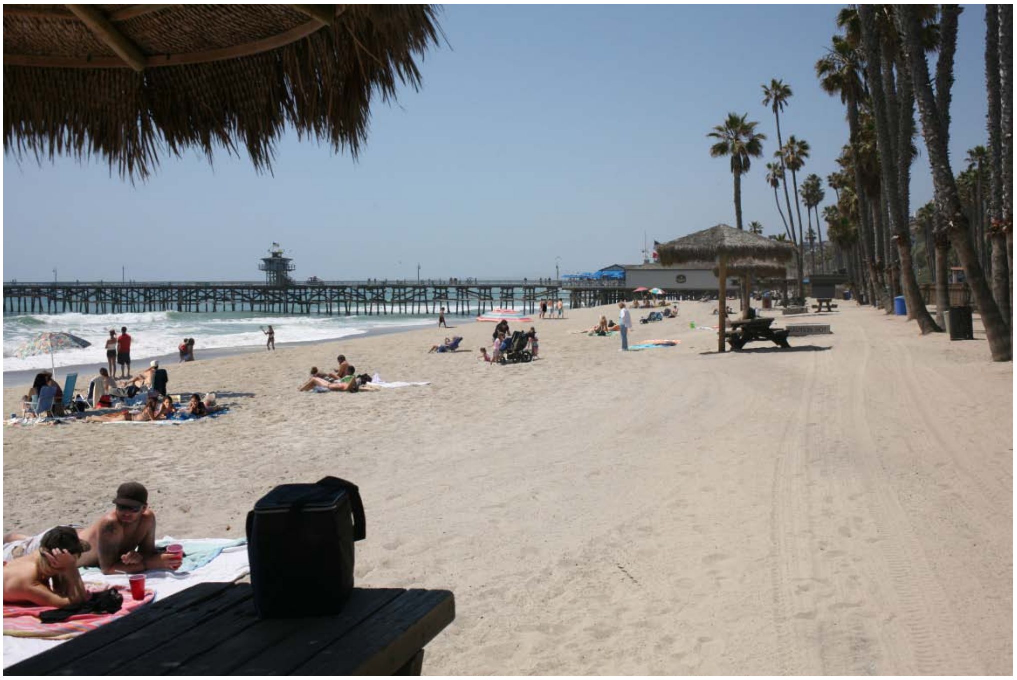


After project

Figure 5-4 View #2: From T-Street Restroom Looking North Towards the Pier



Before project



After project

Figure 5-5 View #3: From North of T-Street Canyon Outlet Looking North Towards the Pier

Before project

After project

Figure 5-6 View #4: From Pier Looking South

Before project

After project

Figure 5-7 View #5: From Pier Looking North

Before project

After project

Figure 5-8 View #6: From South of Marine Safety Building Looking South Towards the Pier

5.3.1 Parking and Access

Per ER 1165-2-130, sufficient public parking and reasonable access must be available in order for the Federal government to participate in shore protection projects. Sufficient parking and public access is provided to the project area. Of the current demand for parking spaces of almost 1100, there are almost that same number of spaces available within a 5-minute walk to the beach and even more spaces available if the distance is extended to 0.8 km (0.5 mi). There are 4 access points to the beach within the project area and one just north of the project area. Additional information on the types of access and parking available can be found in the Economics Appendix.

5.4 General Description of Activities

5.4.1 Beach Replenishment

The recommended plan is expected to perform in a manner consistent with other recent fills within the southern California region. A similar beach nourishment operation was performed in 2001 by the San Diego Association of Governments (SANDAG 2000). The project entailed dredging 1.6 million m^3 (2.1 million cy) of beach compatible sediments from 6 borrow sites for placement on 12 receiver beaches in San Diego County. Extensive project monitoring has been conducted semi-annually since project construction. The similarities of this construction project relative to the morphologic conditions, oceanographic climate, sediment characteristics, and construction techniques make this project directly comparable to San Clemente.

Much of San Diego County is morphologically similar to San Clemente. The similarities include high coastal bluffs, a close-to-shore rock platform, and typically narrow sand beaches (or often none). It is typical that background shoreline change rates throughout the region are small, on the order of -0.3 m/yr (-1 ft/yr) or less. It is noted, however, that the wave/sediment regime within San Diego County can vary substantially alongshore. Due to offshore island sheltering (waves) and submarine canyons (sediment transport), micro wave/sediment climates can and do exist. This makes any specific location-to-location comparisons difficult to substantiate.

Monitoring of the SANDAG receiver sites has been conducted semiannually since project construction. The beach at Oceanside is the transect that is deemed most applicable to San Clemente. At Oceanside Beach, the fill quantity (322,000 m^3 [421,000 cy]), median grain size (0.64 mm [0.03 in]), alongshore length (1,341 m [4,400 ft]), and fill width (56 m [185 ft]) are comparable to the recommended plan of this study, and its performance is deemed representative of expected performance at San Clemente. Estimates based on the SANDAG monitoring data suggest the San Clemente fill will erode on average at a rate of 3.9 meters per year (12.8 ft/yr). The data discussed in Appendix D of the EIS/EIR indicates that a beach fill erodes at substantially higher rates than the native beach. Due to the time varying nature of the wave climate, sediment supply to the beach, and other factors driving longshore sediment transport, it is expected that the beach will erode at a greater rate in some years, at a slower rate in some years, and possibly accrete in other years. According to the Coastal Damage Model results, it is anticipated that a fill will last about five and a half years.

A preliminary estimate of the volume of beach-compatible material was computed for Borrow Area No.2. Approximately 15,650,000 m^3 (20,500,000 cy) of near-shore beach-compatible material was calculated using a 4.5 m (15 ft) dredge depth. This material is suitable for near-shore placement at San Clemente Beach. The preliminary estimated amount of material for the initial placement is 192,000 m^3 (251,000 cy) of material on the beach or in the nearshore environment. The total quantity of sediment required over the 50-year project lifetime based on 8 renourishments is 1,728,000 m^3 (2,260,000 cy). Thus, the sediment volume for the borrow site is sufficient for the recommended project alternative.

Variations in grain size occur within the borrow sediments. The simplifying assumption was made that the fill will be comprised of a blended mix of sediments represented by the mean grain size of the borrow materials. Construction observations on other beach fills within the Los Angeles District indicate a large percentage of borrow material fines are winnowed immediately during placement operations. As borrow materials are placed, the typical high wave energy washes out fines very quickly resulting in the coarser fraction within the fill area. There is little reason to believe that San Clemente will behave differently. Although it is expected that this fill will be constructed by hopper dredge methods, it was not deemed feasible to describe the materials within the fill or the fill performance on a scow-by-scow basis.

Hopper Dredge

This project will be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. Typical Los Angeles District beach fill projects require large capacity open-ocean capable dredges. Operational requirements typically result in hydraulic cutter head and/or hopper style dredges. The borrow site for this project is 35 km (21 miles) from the receiver beach and it is anticipated that the borrow site haul/pumping distance will require hopper dredging equipment utilization. Although Appendix E of the EIS/EIR recommends the use of cutterhead or mechanical dredging methods to ensure the blending of sediments and to reduce % fines, Appendix D of the EIS/EIR has recommended hopper dredging be implemented due to the distance between the borrow and placement sites. Appendix E of the EIS/EIR does state, however, that if hopper methods are used, cuts should be made as deep as possible to obtain the coarsest material possible.

Monobuoy w/ Hopper

The hopper dredge requires a monobuoy to discharge its sand onto the beach. A mono buoy is a floating pipeline connection platform that is moored to the seafloor, and is used to interconnect with a steel sinker pipeline that carries the slurry along the seafloor to the beach. The mono buoy is generally anchored to the seabed at an appropriate depth and location to serve the project needs, depending on locations of sensitive resources and engineering considerations. From one monobuoy location, sand can be pumped directly onshore.

Onshore Placement

The hopper dredge is filled at the designated borrow site at Oceanside and hauled 30 km (18.6 miles) to San Clemente. For the hopper methods, sand is combined with seawater until it reaches the consistency of slurry. At the receiver beach, the dredge is attached to a moored floating section of pipeline extending 450 meters (1,500 ft) to the shoreline. The material is re-suspended and discharged through its on-board pumping system to the receiver site.

Existing sand at the receiver site can be used to build a small, “L”-shaped berm to anchor the sand placement operations. The short side of the “L” is transverse to the shoreline and is approximately the same width as the design beach. The long side is shore parallel, at the seaward edge of the design beach footprint.

When slurry is pumped onto the beach, it is pumped between this berm and toe. This berm reduces ocean water turbidity by allowing all the sand to settle out inside the bermed area while the seawater is channeled just inside the long berm until it reaches the open end where it drains across the shore platform and into the ocean. Temporary dikes within this berm will direct the pumped sand for settlement in designated areas. Once a section of berm is filled in with sand, another berm is created, the pipeline is moved or extended into the new berm area, and the process begins again

As the material is deposited behind the berm, the sand is usually spread using two bulldozers and one front-end loader to direct the flow of the sand slurry and form a gradual slope to the existing beach elevation.

For each receiver site, berm construction may be adjusted from the design requirements during fill placement depending on actual field conditions. The measurements indicated for the width of the berms are the initial placement widths. The berms would be subject to the forces of the waves and weather once constructed, and will eventually settle down to a natural grade for the beach.

Construction Access and Staging Areas

Beach access for the construction equipment and crew will be split between open space on the beach and a city owned public parking lot and is shown in **Figure 5-9**. An open area exists along the beach immediately adjacent and north of the Pier and in the immediate vicinity of the Marine Safety Headquarters. It is expected this site will be used for the contractors' office trailer, parking area for heavy earthmoving equipment, and storage area for dredge pipe and other miscellaneous materials. This site is used extensively for access to the Marine Safety Headquarters and other municipal operations and as such poses no new environmental considerations, minimizes disturbance to the environment, and is ideally located for contractor ease of operations. Although access to this area is controlled by a signal controlled, at-grade railroad crossing, it is anticipated that there will be no significant restrictions on utilization of this portion of the contractors work and storage area.

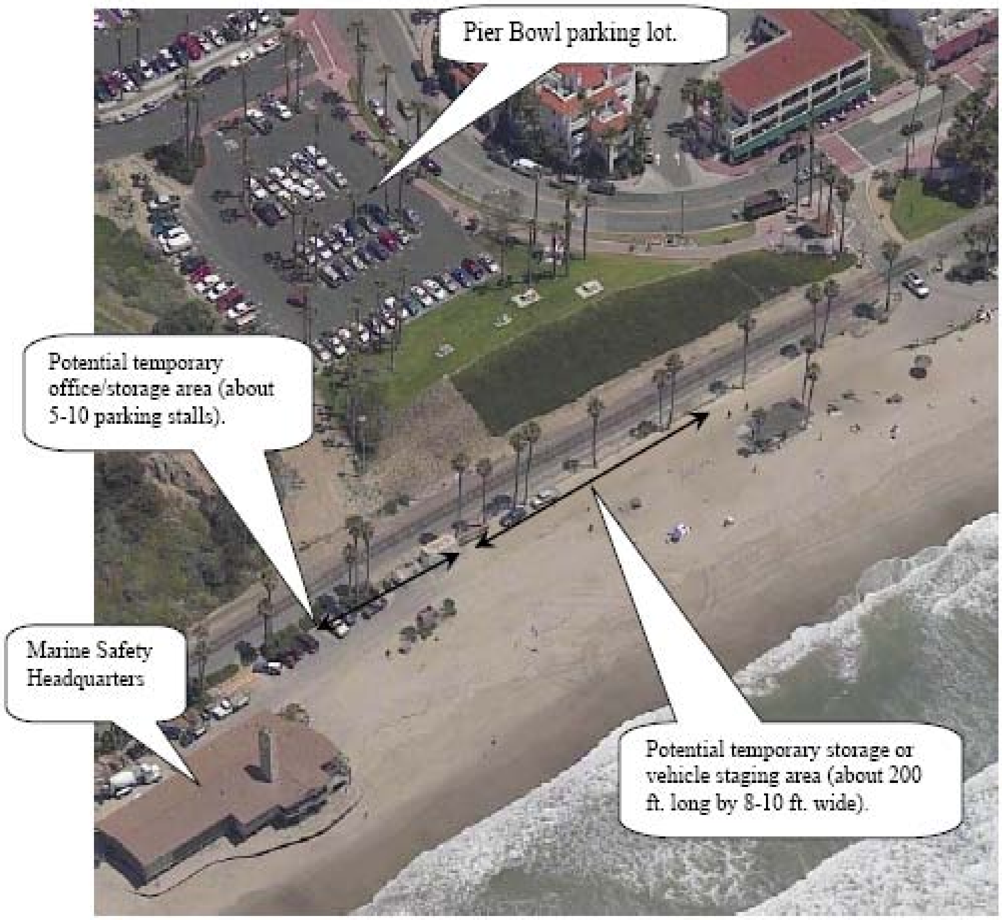


Figure 5-9 Work Storage Area

The Pier Bowl parking lot will also be a component of the contractors' work and storage area. This parking lot is a metered, city-owned parking lot for public access to the beach and pier area. Several parking spaces will be restricted for contractor privately owned vehicles. The contractors' dredge and vessels will require off-site mooring and berthing space. There is no mooring area available within the City of San Clemente. The nearest suitable mooring area is Dana Point Harbor, a small craft harbor approximately 8 km (5 mi) north

Public Access

For the beach fill operation, the only impacts to public beach access would occur at the point of discharge. Approximately 90 m (300 ft) of beach would be inaccessible to the public around the discharge pipeline and berms. In addition, there would be intermittent restrictions on public access for approximately 107 m (350 ft) on either side of this discharge zone. This space would be needed for maneuvering heavy equipment during construction of the temporary berms.

5.4.2 Future Project Beach Profile Monitoring

The purpose of this monitoring is to allow the timing and the detailed design of the periodic nourishment to be optimized. Surveying of the beach and seabed morphology is paramount to the monitoring efforts. Changes in beach and seabed morphology will define the sediment transport patterns at the shoreline and ultimately the short term and long term beach erosion processes. Alongshore transects will be crucial to determine the effects, if any, the proposed project has on updrift and/or downdrift shorelines. The monitoring period will be for the 50-year period of Federal involvement. However, not all aspects of the monitoring plan will be conducted each year. A more detailed description can be found in Appendix D of the EIS/EIR.

5.4.3 <u>OMRR&R Activities</u>

The sponsor is committed to performing operation and maintenance on the existing facilities such as maintaining public access and facilities, and construction of temporary berms. It is not anticipated that there will be incremental costs for performing these activities under the recommended plan, therefore, the operation, maintenance, repair, replacement, and rehabilitation costs over the lifetime, because of the project, are anticipated to be zero.

5.5 Completeness

Guidance in Water Resources Development Act (WRDA) 1996 states that:

> *"(B) RECOMMENDATIONS FOR SHORE PROTECTION PROJECTS.—*
> *(i) IN GENERAL.—The Secretary shall recommend to Congress the authorization or reauthorization of shore protection projects based on the studies conducted under subparagraph (A).*
> *(ii) CONSIDERATIONS.—In making recommendations, the Secretary shall consider the economic and ecological benefits of the shore protection project.*
> *(C) COORDINATION OF PROJECTS.—In conducting studies and making recommendations for a shore protection project under this paragraph, the Secretary shall—*
> *(i) determine whether there is any other project being carried out by the Secretary or the head of another Federal agency that may be complementary to the shore protection project; and*
> *(ii) if there is such a complementary project, describe the efforts that will be made to coordinate the projects."*

This guidance aims to ensure that all areas within the original study area are not at significant risk and to consider other potential Federal government interests. The initial study area included 10 Reaches, but only Reach 6 was brought forward as a viable USACE Civil Works project. The future without project condition assumption is that the SCRRA will construct a seawall along all the reaches if the railroad is at risk for damage dues to waves when a certain criteria is met. It is assumed by this study that those 9 reaches not covered by this project will eventually be protected. There may be additional Federal interest in protecting the railroad because of its national defense significance as a STRACNET. The construction of this project would not limit nor induce actions to reduce the damage risk in the other reaches.

5.6 Environmental Effects of Recommended Plan

Table 5-2 highlights the status of compliance with the applicable Federal and State Environmental Regulations.

Table 5-2 Environmental Compliance

Title of Regulation or Public Law	Compliance
FEDERAL ENVIRONMENTAL REGULATIONS	
National Environmental Policy Act of 1969 (Public Law 91-190) as amended - *42 USC 4321 et seq.*	In Compliance
ER-200-2-2, 33 CFR 230, March 1988 - *33 CFR 230*	In Compliance
Coastal Zone Management Act of 1972 and California Coastal Act of 1976 – *16 USC 1451 et seq.*	In Compliance
Clean Water Act of 1977 (Public Law 95-217) - *42 USC 7401 et seq.*	See paragraph below
Rivers and Harbors Act of 1899 - *33 USC 401-413*	In Compliance
Fish and Wildlife Coordination Act of 1958 (Public Law 85-624) – *16 USC 661-666*	In Compliance
Federal Endangered Species Act of 1973 - *16 USC 1531*	In Compliance
Magnuson-Stevens Fishery Management and Conservation Act, as amended 1996 (Public Law 104-267) - *16 USC 1801*	In Compliance
Marine Mammal Protection Act of 1972 - *16 USC 1361*	In Compliance
Migratory Bird Treaty Act, as amended (16 USC 703-711) - *16 USC 703-711*	In Compliance
Executive Order 11990	In Compliance
Executive Order 11991	In Compliance
National Historic Preservation Act of 1966, as amended (16 USC 479) – *16 USC 470*	In Compliance
Clean Air Act of 1972 - *42 USC 7401 et seq.*	In Compliance
Executive Order 12088	In Compliance
Executive Order 12898	In Compliance
Executive Order 13045	In Compliance
Federal Water Project Recreation Act (Public Law 89-72), July 9, 1965 – *16 USC 4601*	In Compliance
STATE ENVIRONMENTAL REGULATIONS	
California Environmental Quality Act (Public Resources Code, Sections 21000-29 21177)	In Compliance
California Coastal Act of 1976, as amended	In Compliance
Porter-Cologne Water Quality Control Act of 1966 (California Water Code §§13000-13999.10)	In Compliance
California State Lands Commission (Sections 6216 and 6303)	On-going
California Endangered Species Act (California Fish and Game Code Sections 2050-2116)	In Compliance
LOCAL ENVIRONMENTAL REGULATIONS	
South Coast Air Quality Management Plan (AQMP); South Coast Air Quality Management District (SCAQMD) and Southern California Association of Governments (SCAG)	In Compliance

A CWA 404(b)(1) analysis that is complete and is provided in Appendix A of the Final EIS/EIR in accordance with Section 404(b)(1) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) as amended by the Clean Water Act of 1977 (Public Law 95-217). The intent of the analysis is to state and evaluate information regarding the effects of the discharge of dredged or fill material into waters of the United States. The document discusses the effects of the dredging, the initial sand placement and future renourishment actions.

Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem are discussed as avoidance, minimization, and compensation measures. To satisfy requirements of the Federal CWA, USACE will submit this Final EIS/EIR and appropriate technical documentation to the San Diego RWQCB, which is delegated with implementing the CWA within the region, for their review for CWA Section 401 certification, pursuant to 33 CFR 336.1(a)(1). Upon review of the submittal, the RWQCB would evaluate if issuance of a Section 401-water quality certification is appropriate. USACE will continue to coordinate with the RWQCB throughout the remaining study, design and construction phases of this project. USACE has determined that full compliance with CWA Section 404 is met and thus may invoke, if needed, CWA 404(r), once the project is authorized by Congress.

5.6.1 Effects Found

Issues that were brought forward for the proposed San Clemente Shoreline Protection Project for further analysis and included in the accompanying Final EIS/EIR included topography, geology and geography, oceanographic and coastal processes, water and sediment quality, biological resources: including but not limited to essential fish habitat and long-term net loss in the habitat value of surfgrass, kelp beds, or other sensitive biological habitat, cultural resources, noise, socioeconomics, transportation, land use, recreation, public safety, and public utilities. This analysis determined that the proposed project would not have a long-term significant effect on these elements.

Regarding biological impacts, the Corps does not expect to see any impacts to the T-Street reef and the surfgrass vegetation, and thus concludes that no mitigation is required. Nonetheless, if effects are observed, a monitoring, mitigation, and reporting plan (MMRP) has been developed in concert with the resource agencies. This plan will undergo further scrutiny during PED by a team including ERDC Submerged Aquatic Vegetation Restoration Research Program (SAVRRP) experts and the resource agencies. If impacts are not observed, the Corps will continue to monitor for effects and will continue to collaborate with ERDC and the resource agencies to identify an appropriate mitigation design in the future if determined to be needed. Mitigation funds are included as part of the contingency funds for the project. The expectation is that while there may be negligible effects to the inner rocky reef and surfgrass vegetation, actual monitoring data will be needed to support this determination, or to identify that there will be no significant impacts. Monitoring for 2 years immediately post construction is proposed to determine actual impacts

5.6.2 Significant Unavoidable Adverse Effects

The EIS/EIR considered the potential impacts of the proposed alternatives, in addition to the No Action Alternative, according to several resource categories: topography, geology and geography, oceanographic and coastal processes, water and sediment quality, biological resources, cultural resources, aesthetics, air quality, noise, socioeconomics, transportation, land use, recreation, public safety, and public utilities.

5.6.3 Environmental Commitments

Table 5-3 shows the environmental commitments to be undertaken by the Corps to ensure environmental impacts are reduced to a level of insignificance where possible.

Table 5-3 Summary of Design Features and Monitoring Commitments

Design Features	Purpose	Timing	Implementation Responsibility
Air quality			
Use of BACTs and Contingency Measures for construction activities	To reduce air emissions	During all construction activities	Construction contractor
Construction equipment will be properly maintained and tuned	To reduce air emissions	During all construction activities	Construction contractor
Maintain at least a 12 percent saturation level of the sand	To reduce air emissions	During beach fill activities	Construction contractor
Prohibit truck idling in excess of five minutes	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, use aqueous or emulsified diesel fuel for construction equipment.	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, use diesel oxidation catalytic converter	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, require the use of newer, lower-emitting trucks to transport construction workers as well as equipment and material to and from construction sites	To reduce air emissions	During all construction activities	Construction contractor
Water Quality, Sediments, Oceanography			
Construct "L"-shaped berms	Anchor sand placement operations and reduce nearshore turbidity	During beach fill	Construction contractor
Monitor turbidity	To reduce impacts related to turbidity	During dredging and beach fill activities	Construction contractor
Prepare SWPPP and OSPRP	Ensure minimal contamination from fuel leaks, if any	During all construction activities	Construction contractor

Design Features	Purpose	Timing	Implementation Responsibility
Cultural Resources			
Prior to construction, offshore borrow areas 1 and 2 will be subjected to an underwater remote sensing survey in order to determine if submerged cultural resources are present within these areas.	Avoid potentially undisturbed, submerged cultural resources.	Prior to dredging activities	Construction contractor
Noise			
On-shore construction activities must be limited to less than 12 hours per day.	Minimize noise emissions	During beach nourishment/notch fill	Construction contractor
Recreation			
The contract specifications shall require the contractor to fence/secure off areas of construction from public access, including construction staging areas and active construction areas, including the beach and nearshore zone.	Avoid safety hazards to recreation-goers	During beach nourishment	Construction contractor
Biological Resources			
The project includes a Monitoring and Mitigation Plan (see Appendix B of the EIS/R) to account for potential impacts to biological resources once the placed sand has equilibrated. No impacts are expected, however, the Plan will account for any potential impacts.	Minimize biological impacts	Monitoring 2 years prior to and post-construction	Construction contractor and Corps Project Managers and PED designers.

Design Features	Purpose	Timing	Implementation Responsibility
Public safety			
The dredge would be equipped with markings and lightings in accordance with the U.S. Coast Guard regulations. The location and schedule of the dredge would be published in the U.S. Coast Guard Local Notice to Mariners. The dredge would travel at very low speeds (approximately 1.5 knots) during dredging operations. The travel speed during transport would be approximately 5 knots. During dredging and nourishment activities, proper advanced notice to mariners would be obtained, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area offshore of Oceanside.	Warn boaters/ fishermen of dredging activities to ensure avoidance	Before and during dredging activities and beach nourishment	USACE resident engineer
Socioeconomics			
The local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations.	Avoid gear conflicts and provide for compensation if loss occurs	Thirty days prior to the start of construction	Coast Guard (via construction contractor) and USACE

Design Features	Purpose	Timing	Implementation Responsibility
Monitoring Commitments			
Monitor turbidity levels	To avoid turbidity impacts to fish and aquatic species	During dredging operations and beach fill activities	Construction Contractor
Any earthmoving associated with this project that will involve previously undisturbed soil will be monitored by a qualified archeologist who meets the Secretary of Interior's Standards for an Archeologist (see 36 CFR Part 61). If a previously unidentified cultural resource (i.e., property) that may be eligible for the NRHP is discovered, all earthmoving activities in the vicinity of the discovery shall be diverted until the USACE complies with 36 CFR § 800.13(a)(2).	Avoid any potentially undisturbed cultural resources.	During beach fill activities	Construction Contractor, qualified archeologist, in coordination with USACE
Monitor for grunion spawning in construction area, until eggs hatch (minimum of one lunar month) and surveys show no subsequent spawning	Avoid grunion eggs and protect until hatched	April through September and per CDFG annual pamphlet *Expected Grunion Runs*.	Qualified biologist

6 IMPLEMENTATION OF THE RECOMMENDED PLAN

6.1 General

This chapter presents the Federal and non-Federal responsibilities for implementing the recommended plan. This includes Federal and non-Federal project cost sharing requirements and the division of responsibilities between the Federal government and the Non-Federal Sponsors, the City of San Clemente. It also lists the steps toward project approval, and a schedule of the major milestones for the design and construction of the recommended plan.

6.2 Cost Apportionment for the Recommended Plan

Cost sharing for initial construction of the recommended plan would be consistent with that specified in Section 103(c)(5) of WRDA 86 as amended by WRDA 96 (generally 65 percent Federal and 35 percent non-Federal). Cost sharing for periodic nourishment (continuing construction) would be consistent with Section 103(d) of WRDA 86 as amended by Section 215 of WRDA 99, which requires that such costs be shared 50 percent Federal and 50 percent non-Federal. The final division of specific responsibilities will be formalized in the project partnership agreement (PPA).

These general cost shares apply for developed public or private shores where there is adequate public access and use. For public non-Federal shores, such as a park, the cost sharing for initial construction and each renourishment is 50/50 and for private non-developed shores the cost sharing is 100 percent non-Federal. Federal shores are cost shared 100 percent Federal.

The study area consists mostly of developed public shores and will be therefore subject to the general cost sharing of 65% Federal, 35% non-Federal for the initial project and 50/50 for each renourishment.

Table 6-1 displays the study area land use in terms of shoreline length.

Table 6-1 Study Area Land Use

Land Type	Length
Developed public	1040 m
Total Project Length	**1040 m**

Tables 6-2 and **6-3**, below, display the currently assumed Federal cost sharing for initial construction and each renourishment respectively.

Table 6-2 Federal Cost Share: Initial Construction

Land Type	Percent Federal Share
Developed public	65%

Table 6-3 Federal Cost Share: Renourishment

Land Type	Percent Federal Share
Developed public	50%

Based on these calculations, cost sharing for the project will be as follows:

- Initial construction costs, including sunk costs, are cost shared at 65% Federal and 35% non-Federal.
- Costs for project performance monitoring in support of continuing construction, used to refine plans for the beach renourishment, are cost shared at 50% Federal and 50% non-Federal.
- Total beach renourishment costs are cost shared at 50% Federal and 50% non-Federal.

Table 6-4 indicates that the project first costs at January 2011 Price Levels are $11,100,000 of which non-Federal costs total $3,880,000 and Federal costs total $7,220,000.

Table 6-4 Federal and Non-Federal Initial Costs of the Recommended Plan
January 2011 Price Levels

		Non-Federal		Federal	
	Total Cost	**%**	**Cost**	**%**	**Cost**
Cash	**$11,100,000**		**$3,870,000**		**$7,220,000**
Real Estate (LERRDs)	**$12,000**		**$12,000**		
Cost Share: First Costs	**$11,100,000**	**35**	**$3,880,000**	**65**	**$7,220,000**
Cost Share: Continuing Construction	**$84,900,000**	**50**	**$42,500,000**	**50**	**$42,500,000**

Finally, **Table 6-5** illustrates the fully funded cost apportionment for the total project. It shows that the fully funded project cost is $154,000,000 of which $75,500,000 (49%) is non-Federal and $78,500,000 (51%) is Federal.

Table 6-5 Federal and Non-Federal Cost Apportionment for the Total Project
Fully Funded Cost Estimate

Item	Total Project Cost	Non-Federal Cost	Federal Cost
Initial Construction			
Cash	$11,200,000	$3,910,000	$7,280,000
Non-Federal LERRD's	$12,000	$12,000	
Total Initial Cost	$11,200,000	$3,920,000	$7,280,000
Total Continuing Construction Cost (not discounted)	$142,000,000	$71,200,000	$71,200,000
Total Project Cost	$154,000,000	$75,000,000	$78,000,000
Percentage Share		49	51

The Total Initial Cost for nourishment includes initial sand costs, Mob/Demob, PED, SA, and Non-Federal LERRD's. The Total Continuing Construction Cost is the total cost of the project, including nourishments and monitoring, after the initial fill is constructed. Fully Funded Project Cost is the sum of Total Initial Cost and Total Continuing Construction Cost.

6.3 Division of Plan Responsibilities

The Federal Government and the City of San Clemente are responsible for implementation of the recommended plan, including the sharing of costs and maintenance. In addition, certain responsibilities are required by each party in accordance with Federal law.

6.3.1 Federal Responsibilities

Responsibilities of the Federal Government for implementation of the recommended plan include:

a) Sharing a percentage of the costs for Planning, Engineering and Design (PED), including preparation of the Plans and Specifications, which is cost shared at the same percentage that applies to construction of the project.
b) Sharing a percentage of construction costs for the project.
c) Administering contracts for construction and supervision of the project after authorization funding, and receipt of non-Federal assurances.

6.3.2 Non-Federal Responsibilities

Federal law requires that a local non-Federal sponsor provide and guarantee certain local cooperation items to ensure equitable participation in a project and to ensure continual maintenance and public receipt of the intended benefits. The particulars of the recommended plan were carefully reviewed and a set of applicable project partnering items established to include cost sharing of the Project as prescribed in the above paragraphs. The local non-Federal sponsors will:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits (See **Table 6-2** and **Table 6-3**) and as further specified below:

(1) Enter into an agreement that provides, prior to construction, 25 percent of design costs;
(2) Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;
(3) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;
(4) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

g. Assume, as between the Federal government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree, as between the Federal government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)).";

k. Provide the non-Federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

m. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element; and

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Corps of Engineers.

6.4 Local Sponsor Financial Capability

Local funds for this project will be provided by the City of San Clemente and the State of California, through the California Department of Boating and Waterways. The California Department of Boating and Waterways' Beach Nourishment Program is funded through annual appropriations. Under that Program the State will fund 85% of the local share and the City will be required to contribute 15% of the local share.

6.5 Project Partnership Agreement

Prior to advertisement for the Construction Contract, a Project Partnership Agreement (PPA) will be required to be signed by the Federal Government and the City of San Clemente, requiring formal assurances of local cooperation from the City. This agreement will be prepared and negotiated during the Plans and Specifications Phase.

6.6 Approval and Implementation

The necessary reviews and activities leading to approval and implementation of the recommended plan are listed below:

a. Environmental Impact Statement Filing - the FEIS will be circulated to State and Federal Agencies as directed by HQUSACE for the 30-Day State and Agency review. The District will concurrently distribute the FEIS to parties not included on the HQUSACE mailing list. The District will then file the decision document and FEIS together with the proposed report of the Chief of Engineers with EPA.

b. Chief of Engineers Approval - Chief of Engineer signs the report signifying approval of the project recommendation and submits the following to ASA (CW): the Chief of Engineers Report, the FEIS, and the unsigned ROD.

c. ASA (CW) Approval - The Assistant Secretary of the Army for Civil Works will review the documents to determine the level of administration support for the Chief of Engineers recommendation. The ASA (CW) will formally submit the report to the Office of Management and Budget (OMB). OMB will review the recommendation to determine its relationship to the program of the President. OMB will approve the release of the report to Congress.

d. Funds could be provided, when appropriated in the budget, for preconstruction, engineering and design (PED), upon issuance of the Division Commander's public notice announcing the completion of the final report and pending project authorization for construction.

e. Surveys, model studies, and detailed engineering and design for PED studies will be accomplished first and then plans and specifications will be completed, upon receipt of funds.

Construction would be performed with Federal and non-Federal funds, once the construction project was advertised and awarded.

7 PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

7.1 Coordination and Public Views

Public workshops, scoping meetings, and coordination with Federal, State, and local agencies have been accomplished to aid in the formulation and evaluation of the proposed recommended plan.

The final Feasibility Report, EIS/EIR has been coordinated with representatives from EPA, US Fish and Wildlife Service, National Marine Fisheries, California State Fish and Game, and the City of San Clemente.

7.2 Public Involvement

A Public Involvement Program was established for the feasibility study, and is being accomplished through representatives from the City of San Clemente, and the Corps of Engineers, Los Angeles District. Activities include:

- The City of San Clemente and Corps of Engineers, Los Angeles District websites will be used to provide information on the study status, updates, meeting schedules and summaries.
- Development of a public informational brochures, project messages, and vehicles for administering public participation in the study and decision making process.
- Preparation of newspaper articles.
- Public Workshops and meetings are to be held to obtain public views, comments, and opinions on factors that should be considered in the study, review of study results, and decision-making on alternatives to be considered and proposed recommendations.

7.3 Public Workshop

A co-chaired public workshop was held on 10 January 2002 at the San Clemente Senior Center to inform the public of the feasibility study and to solicit public input. Additionally, an overview of the NEPA/CEQA compliance regulations was presented along with the announcement of the initiation of the public scoping period. The intent of the scoping process is to encourage participation in the environmental review process from public agencies, special interest groups and the general public in the identification of the key issues and concerns relevant to the scope of the EIS/EIR.

There were about 50 people who attended the public workshop or submitted information, representing a number of agencies, interest groups, and local residents. Some of the agencies and interest groups participating in the meeting included San Clemente Coastal Advisory Committee, San Clemente Marine Safety Division, San Clemente Beaches, Parks, and Recreation Commission, San Clemente Ocean Festival, Capistrano Bay District, Citizens and Surfers of San Clemente, Surfrider Foundation, Restore the Shore/Railroad Corridor Safety Education Panel, and California Lobster and Trap Fishermen's Association.

The response from the general public who attended the session was generally positive. Many of the participants voiced support for efforts to restore the San Clemente Beaches, though there were also many concerns and questions regarding potential adverse impacts.

7.3.1 Public Concerns

A number of public concerns have been identified during the Public Workshop. Additional input was received through coordination with the sponsor and other agencies. The public and agency concerns form the bases of the initial problem and needs statements addressed in this report, and considerations that should be addressed in developing and evaluating alternative plans. The comments and suggestions received have been summarized as follows, in no particular order:

a. Use of groins or other hard structures. There was general opposition and concern expressed on the use of groins or other hard structures to retain sand on the beach.
b. Impacts of revetment and seawalls. Concern was expressed regarding the impacts of revetment and seawalls on exacerbating erosion.
c. Impacts of Dana Point Harbor. Several interests expressed concern with the impact of Dana Point Harbor on sand movement towards the San Clemente Beaches.
d. Impacts of San Juan Creek. Many indicated concern with the impacts of actions in the San Juan Creek watershed, such as sand mining and paving, that is reducing the watersheds sand and sediment contributions to the San Clemente coast.
e. Consideration of managed retreat. Several indicated a desire for managed retreat to be considered as an alternative measure to meet study objectives.
f. Consider aesthetics. An interest expressed the need to consider aesthetics as part of evaluating alternative plans.
g. Desire for continued monitoring. The need to continue monitoring the coast including the beach, surfing areas, and near shore ecosystem was expressed as an important part of any study or project.
h. Impact on nearshore resources and ecosystem. Damage to surf grass and lobsters was noted as a major concern to commercial fishermen as well as recreation snorkeling.
i. High cost of sand rapidly lost. A concern was expressed on the high cost of sand renourishment and the rapid erosion of the material as experienced with recent sand replenishment projects.
j. Time requirements and need for temporary solution. There was concern expressed on the relatively long period of time required to implement a permanent solution, and that a temporary measure should be taken as soon as possible to reduce the current vulnerability of the beaches and associated development.
k. Impacts on surfing breaks and reefs. Concern was expressed on the impact of plans on various surfing wave breaks including point breaks, reef breaks, and beach breaks. These breaks will be impacted differently by different shore protection measures. Riveria is going to be impacted strongly, if there is sand dumped there. The beach breaks, basically are going to be heavily impacted by any sand replenishment project.
l. Consider impacts to local businesses and community. The study should consider the impacts of continued erosion and loss of the recreation beaches and the benefits of restoring the beach on local businesses and the community.
m. Analysis of Historic Littoral Cell Conditions . There is interest in an analysis being made of the entire littoral cell to include sediment changes over seasons and time, the impacts of storms, and consideration of developing an equilibrium condition between sand sources and losses along the San Clemente beaches.
n. Artificial surfing reefs. There was interest in consideration of artificial surfing reefs such as Pratt's reef, to be considered in the study, which could improve surfing as

well as reduce erosion of the beaches. This could include consideration of using geo-textile bags to create "narrow neck reefs" to meet these objectives.

o. Opportunistic beach fill program. It was noted that the City of San Clemente has an Opportunistic beach fill program to allow suitable beach material to be placed on the beach as various projects make such material available.
p. Surfing is critical to the community culture of San Clemente. It was noted that the City of San Clemente was one of the centers of developing California's surfing interest, and there are numerous organizations and businesses that support this activity.
q. Railroad relocation. It was noted that there have been discussions regarding the possible relocation of the railroad line as part of high-speed rail, double tracking and other projects. Accordingly, the study should consider the potential for relocation of the railroad including possible beneficial impacts to the beaches and recreation use.
r. Quality of sand. Some concerns were mentioned on the quality of the material to be placed on the beach and the potential for fine silty material to cause impacts to the nearshore ecosystem.
s. Consideration of public safety and public access. It was noted that the existing rail line limits access to the beach and causes major public safety concerns. This should be addressed as part of the study.

A 45-day public review of the Draft EIS/EIR was conducte in August and September of 2010. A final public meeting was held on August 19, 2010 to present the findings of the study and to provide the public an opportunity to express their views on the results and recommendations of the pre-authorization study. Comments included concerns with some of the engineering and environmental assumptions and analyses and the need to develop an acceptable "monitoring and mitigation plan". All comments have been addressed and our responses are included in the Section 14.0. Additional conference calls and meetings with the Resource Agencies were held to address some of their concerns over the "monitoring and mitigation plan" and revisions have been made to Appendix B based on these discussions.

7.4 Institutional Involvement

7.4.1 Study Team

During the feasibility study, staff from the Corps of Engineers, Los Angeles District, the City of San Clemente, the State of California Boating and Waterways, and other interests participated in developing and analyzing information for the study. They participated directly in the study effort and on the Executive Committee. This involvement is expected to lead to the general support for the implementation of a *recommended plan*.

7.4.2 Agency Participation

During the feasibility study, coordination with the U.S. Fish and Wildlife Service (USFWS) was conducted in accordance with the Fish and Wildlife Coordination Act. The USFWS will be providing the Corps with a Planning Aid Letter Report, Coordination Act Report that includes their views on the *recommended plan* and will be included in the final feasibility report issued for public review. The USFWS will also provide a final Coordination Act Report, which will be included in the final report. All USFWS recommendations have been given full consideration. The USFWS has coordinated their report with the National Marine Fisheries Service and the California Department of Fish and Game. The Planning Aid Report provided by USFWS will present substantial information on ecosystem conditions including types of species and habitats, as well as threatened and endangered species related to the study area. The report also includes a preliminary evaluation of potential impacts associated with the alternative plans considered in the study. Based on this evaluation, the Planning Aid Report will provide recommendations to be considered in developing and evaluating alternative plans.

7.5 Additional Required Coordination

The final report on the study results and tentative recommendations will be formally coordinated with a number of Federal and State agencies as required by Federal and state laws and policies. The final report includes a Coastal Consistency Determination, which will be submitted to the California Coastal Commission for their concurrence in the findings. The final report will also be submitted to the Regional Water Quality Control Office for their approval related to the Clean Water Act as well as regional Air Quality Control offices. The final report and proposed recommendations will be provide to the State Historic Preservation Officer for their approval on the impacts and recommendations associated with cultural and historic resources. Other Federal and State agencies that will receive copies of the final report for their review and approval include Federal and State Environmental Protection Agencies, the State Clearinghouse, and other agency interests.

Other organizations that have participated in the study process to date and will be requested to provide formal comments include the following agencies and groups:

Federal Agencies

U.S. Fish and Wildlife Service
U.S. Geological Survey
National Marine Fisheries Service
National Fish and Wildlife Foundation
Environmental Protection Agency

Local Committees/Groups

Surfrider Foundation, International Headquarters
California Lobster and Trap Fishermen's Association
Capistrano Bay District
Citizens and Surfers of San Clemente
Restore the Shore/Railroad Corridor Safety Education Panel
Southern California Wetlands Recovery Project

State Agencies

California Department of Boating and Waterways
California State Resources
California State Lands Commission
California Coastal Commission
California Coastal Conservancy
California Department of Fish and Game
California Regional Water Quality Control Board
California Regional Air Quality Control Board
California State Historic Preservation Officer

County of Orange Agencies

County Board of Supervisors
Orange County Beach Group
Orange County Transportation Authority

City Governments

San Clemente & San Juan Capistrano
San Clemente Coastal Advisory Committee
San Clemente Beaches, Parks, and Recreation Commission
San Clemente Marine Safety Division
San Clemente Ocean Festival

7.6 Report Recipients

A mailing list of Federal, State, County, local and regional agencies, environmental organizations, and interested groups and individuals is available upon request. These interests will receive notice of the availability of the draft and final feasibility report documents and other notifications on report and project decisions and status.

8 RECOMMENDATIONS

I recommend that the selected plan for storm damage risk reduction along the shoreline within the corporate boundaries of the City of San Clemente as described in this report be authorized as a Federal project; with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable. The recommended plan is estimated to have an initial total cost of $11,100,000 (January 2011 price levels). Of this cost, 65%, or $7,220,000 will be the responsibility of the Federal Government and, 35%, or $3,880,000 will be the responsibility of the City of San Clemente.

The recommended plan further includes periodic nourishment at 6 year intervals within the 50-year project lifetime for a total of eight periodic renourishment episodes, project beach monitoring for periodic nourishment planning, environmental monitoring, and mitigation plans, if required as described in Appendix B of the EIS/EIR. The recommended plan is estimated to have an average annual cost for construction of $2,140,000 over the 50-year project lifetime and a total continuing construction cost of $84,900,000 (January 2011 price levels). Of this cost, 50% or $42,500,000 will be the responsibility of the Federal Government and 50% or $42,500,000 will be the responsibility of the City of San Clemente.

This recommendation is made with the provision that before implementation, the City of San Clemente will, in addition to the general requirements of law for this type of project, agree to the following requirements:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits (See **Table 6-2** and **Table 6-3**) and as further specified below:
   (1) Enter into an agreement that provides, prior to construction, 25 percent of design costs;
   (2) Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;
   (3) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;
   (4) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

g. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)).";

k. Provide the non-Federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

m. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element; and

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Federal Government.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

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