COASTAL REGIONAL SEDIMENT MANAGEMENT PLAN

FOR THE SAN DIEGO REGION

Prepared for:

SANDAG

401 B Street, Suite 800
San Diego, CA 92101-4231

and

The California Coastal Sediment Management Workgroup

135 Ridgway, Santa Rosa, CA 95401

Prepared by

moffatt & nichol

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

In Association with:

Everest International Consultants

And

Science Applications International Corporation

MARCH 2009

FINAL

COASTAL REGIONAL SEDIMENT MANAGEMENT PLAN

FOR THE SAN DIEGO REGION

Prepared For:
SANDAG
401 B Street
Suite 800
San Diego, CA 92101-4231

And The

California Coastal Sediment Management Workgroup
135 Ridgeway
Santa Rosa, CA 95401

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

In Association With:
EVEREST INTERNATIONAL CONSULTANTS
And
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

March 2009

This Plan is funded in part with qualified outer continental shelf oil and gas revenues by the Coastal Impact Assistance Program, Bureau of Ocean Energy Management, Regulation, and Enforcement, U.S. Department of the Interior.

EXECUTIVE SUMMARY

Introduction

This San Diego Coastal Regional Sediment Management Plan ("Coastal RSM Plan" or "Plan") has been developed by the San Diego Association of Governments (SANDAG) and the California Sediment Management Workgroup (CSMW). This Plan was developed to inform the public and decision-makers on sand deficits and related issues within the region, and proposes solutions for existing sediment[1] management problems along the coast. Insufficient sediment or sand volumes exist along the San Diego County shoreline, leading to coastal erosion, narrowing of beaches, damage to infrastructure, habitat degradation, and reduced recreational and economic benefits. Historical records indicate that regional urbanization and the associated development of flood control works and harbors have reduced the supply of sand to the shore by approximately 400,000 cubic yards per year. SANDAG prepared the Shoreline Preservation Strategy (SPS) in 1993, concluding that the region needed approximately 30 million cubic yards of sand to restore the coastline and nearly 400,000 cubic yards per year thereafter for maintenance. This information establishes a baseline guideline for the level of comprehensive nourishment needed for the San Diego region considered within this Coastal RSM Plan.

SANDAG conducted significant public outreach efforts across most of the County during development of this Plan. Efforts included workshops, mailings, and periodic presentations at the SANDAG Shoreline Preservation Working Group (SPWG), the stakeholder advisory group providing recommendations on shoreline management efforts, including Plan development and its subsequent implementation. Entities within the San Diego region that need to be involved in coordinated coastal sediment management include SANDAG, the CSMW, resource and permitting agencies not included in the CSMW, the County, California State Parks, coastal cities, and local stakeholders (local Watershed Planning Groups, Scripps Institution of Oceanography (SIO), lobster and commercial fishermen, the Surfrider Foundation, Homeowner Groups, and City Beach Erosion Committees).

Coastal Processes

The San Diego region's coastline is separated into three littoral cells. The Oceanside Littoral Cell stretches from Dana Point in Orange County to Point La Jolla. The Mission Bay Littoral Cell extends from Point La Jolla to Point Loma, and the Silver Strand Littoral Cell covers the reach from San Diego Bay's entrance to Mexico. The large Oceanside Littoral Cell is artificially divided by Oceanside Harbor's north jetty, which effectively eliminates significant transport of littoral sand from the northern portion of the littoral cell to downcoast of the Harbor. The presence of Marine Corps Base Camp Pendleton (MCB Camp Pendleton) upcoast of Oceanside Harbor limits SANDAG's ability to coordinate regional sediment management in the northern part of the Oceanside Littoral Cell. For these reasons, this Coastal RSM Plan focuses on the Southern Oceanside, Mission Bay and Silver Strand littoral cells.

[1] Sediment and sand are used interchangeably in this report to refer to relatively small-grained geologic material that composes the sediment lense on beaches and within the shallow ocean. While sediment is a general term for material ranging in grain size from clay to gravel, this Plan focuses on managing sandy sediments that consist of at least 51 percent (or more) sand for contribution to the coastal ocean to increase volumes of sand at the beach.

Coastal processes in this region are affected by waves that drive the rate and direction of longshore currents and sediment transport. This coast is exposed to waves from both the northern and southern hemispheres through a very broad window, from northwest to south-southeast. Consequently, longshore currents and sediment transport vary with season and climatic cycle. Higher energy waves from the Pacific Northwest cause net southerly longshore transport in the Oceanside and Mission Bay Littoral Cells. However, net longshore transport is to the north in the Silver Strand Cell due to local wave refraction around the large bathymetric features of Point Loma and the Tijuana River Delta. Overall, the net longshore transport rate is relatively small in all cells, which indicates significant bi-directional transport throughout the region. All three littoral cells experience sand deficits in their sediment budgets indicating ongoing sand loss. SIO is investigating subcells that may affect sediment transport in the vicinity of the region's lagoons. Longshore sediment transport appears to change to offshore transport near lagoon mouths.

Climate change, specifically sea level rise, is a concern within the San Diego region as well as elsewhere along the California coast. Projected sea level rise has the potential to inundate critical habitats and important recreational areas, and cause significant economic losses to the region through reduction of tourism revenues and increased storm damages to critical infrastructure. Solutions presented within this Coastal RSM Plan are targeted to address the effects of sea level rise at the critical receiver sites discussed herein. Other solutions, such as managed retreat, may be feasible and appropriate at other locations along the coastline. California State Parks owns many of the beaches within this County and has indicated a disfavor of hard structures at state-owned beaches.

Due to ongoing losses through normal littoral transport processes and the anticipated effects associated with sea level rise, SANDAG has determined that some means to effectively retain the sand for longer periods of time must be found if the nourishment programs are to be effective in maintaining and restoring habitat, recreation, and minimizing economic losses through reduction in tourism and increased storm damage. Based on this advice, SANDAG is investigating the retention of sand through sediment management devices, including modeling to demonstrate their effectiveness.

SANDAG is committed to nourishing the region's beaches to maintain a high quality of life, and desires to determine whether various types of retention are technically feasible and politically acceptable. Such devices, if determined to be feasible, will then require thorough environmental analyses to assess adverse and beneficial impacts, and rigorous public review to determine political acceptability. Specific sediment management devices are not currently recommended within this Plan, as conditions at specific locations may affect physical feasibility. However, SANDAG has expressed interest in the submerged reef concept, which has the potential to retain sand, minimize adverse visual impacts, increase rocky bottom habitat, and improve surfing conditions.

Biological Constraints

Significant environmental constraints exist within this region in the form of sensitive marine and coastal habitat and biota. Coastal habitat areas of particular concern (HAPCs) include rocky reefs, canopy kelp, and seagrass beds (surfgrass, eelgrass) and rare habitats such as native coastal dune and strand. Several state-managed species of commercial or recreational importance such

as California spiny lobster and sea urchins are associated with hard bottom or vegetated habitats. Additional HAPCs that could be adversely impacted by the addition of sediment to the littoral system include estuaries, particularly lagoon and estuary entrances, river mouths, and bays and harbors. While sand is the primary constituent of sandy beach and subtidal areas, sediment placement is disruptive and generally results in temporary impacts to existing biota. While most habitat constraints to beach nourishment are associated with hard bottom habitats, particularly those supporting surfgrass and kelp, other areas such as lagoons and certain sandy beaches also are sensitive due to their inhabitants and site use. Sensitive habitats will require pre-project assessments and monitoring during and after nourishment to ensure their ability to support and nurture biota is not adversely impacted.

While total loads of sediment reaching the ocean have been decreasing, a disproportionate amount ends up trapped in coastal wetlands, due to factors related to urbanization such as unstable inlets, decreased tidal prisms, and ecosystem fragmentation. Routine maintenance dredging is required at most lagoons and harbors in the region and sediment placement at beaches provides a beneficial reuse of suitable maintenance dredged materials. Healthy beaches are important for maintaining the integrity of the wetland systems existing behind them. Habitat quality may affect managed or sensitive species uses of beaches, including California grunion, Pismo clams, and shorebirds including threatened western snowy plover.

Specific concerns relate to the threatened snowy plover's critical habitat, including nesting and wintering locations, as well as the endangered least tern's nesting locations. Least terns are visual predators on small schooling fish and their chicks are vulnerable when left unattended at nesting sites. The potential for construction-related disturbance or turbidity generated during sediment placement to interfere with nesting or foraging success are concerns that require protective measures when these protected species are nearby. The suitability of habitat for grunion spawning or their presence during beach nourishment needs to be evaluated and protective measures implemented if necessary. While other sensitive biota may be present at or near project locations, measures implemented to protect water quality and sensitive habitats are generally protective of other species.

Beach nourishment projects need to evaluate potential impacts on the habitat in the project vicinity, and establish protocols that avoid or minimize the negative impacts while increasing beneficial impacts to these vulnerable natural resources. This Coastal RSM Plan takes an important step forward in advancing the protection, enhancement, and restoration of these critical habitats and valuable biota by compiling existing information on occurrence, displaying such occurrence through figures, tables and GIS shapefiles, and describing the steps needed during various project phases to protect and enhance the biota and habitats. Future environmental assessments, permitting, and similar efforts will benefit significantly from this compilation effort.

Sediment Sources

Potential sediment sources in the region include nearly 60 presently-known sites, including various types of upland sources, coastal wetlands and harbors, and sands located offshore outside of the littoral zone. Each type of sand source is summarized below.

Offshore sources are actively being investigated by SANDAG, SIO, and others. This source type represents the largest economically-viable source of sediment within the region. The interruption of sediment transport by Oceanside Harbor's northern jetty has created an extensive deposit of high quality sand upcoast of the jetty, representing a large potential nearshore source if SANDAG and MCB Camp Pendleton can reach agreement on the procurement of that sand.

Many of the coastal wetlands (e.g., lagoons) within the region are in need of restoration due to the accumulation of sandy material, and represent large potential new sources of littoral sediment for nourishment of the beaches in their vicinity. Also, maintenance dredging of active harbors, restored lagoons, and river mouths enables trapped sediment to re-enter the littoral zone and replenish sediment deficits.

Most viable upland sources exist within the coastal zone, with fewer cost-effective sources located away from the coast. Potential sources of upland sediment include construction projects, highway widening, and various flood control structure. Sediment detention basins could also possibly provide a sustained source of sand. Temporary sediment stockpiling will likely be necessary to facilitate truck delivery from upland sources to the coast. Constraints to delivering upland sediment to the coast include prohibitive trucking transport costs, and limited time windows during the year when trucks can access the beach due to environmental, recreational, or public safety concerns. An additional constraint on upland and wetland restoration sources is the sand size and gradation that can be placed at the beach. An on-going study by the CSMW and its state, federal, and local partners (Tijuana Estuary Sediment Fate and Transport Science Study) is assessing the turbidity and sedimentation impacts associated with upland source materials containing a relatively high percentage of fine-grained sediment.

Sediment Receiver Sites

Twenty-six sites along the coast from Oceanside to Imperial Beach, documented to be eroding or with a deficit of sediment, have been identified to be of concern to state, federal, or local agencies. Consequently, these sites are included for consideration in this Coastal RSM Plan. The receiver sites include: 1) onshore locations recommended for opportunistic beach fill programs utilizing upland sediment; 2) onshore placement areas used by SANDAG in 2001 for regional nourishment; 3) onshore and nearshore sites historically used by the U.S. Army Corps of Engineers (USACE) or U.S. Navy for placement of maintenance dredging materials from various sources; 4) onshore sites presently used for lagoon and harbor maintenance dredging; and 5) onshore and nearshore placement areas anticipated to be useful for future wetlands restoration and maintenance.

Beach erosion is continually documented by the federal, state, regional, and local governments. The CSMW focuses on addressing statewide sediment management and has systematically inventoried Beach Erosion Concern Areas (BECAs) throughout coastal California, including those of local concern in selected areas of the coast. Additional locations may exist along the coast where other management options (e.g., managed retreat) may be appropriate to address coastal erosion, and future efforts may determine that not all of the BECAs identified within this Plan may be appropriate for sediment placement. The current list of proposed BECAs should be considered as a master planning list that can be added to or subtracted from as efforts associated with implementation of this Plan proceed. Table 2 (page 30) and Figures 7 and 8 (pages 32 and 33) identify the BECAs currently identified as of concern to local, state, and federal interests.

Solutions

Restoration of the region's beaches will require a long-term sustained effort. Two Management Alternatives for the addition of new sediment to the beaches are presented for consideration. An adjustment to how sediments from harbor and lagoon maintenance are placed along the coastline is recommended. Wetland restoration efforts are anticipated throughout the region, and placement of appropriate sediment generated during their restoration on nearby beaches could help both wetland and beach restoration efforts, and reduce overall costs. Finally, the release and redistribution of sediment trapped upcoast of Oceanside Harbor could significantly contribute to the region's sediment budget. However, this would require regional cooperative agreements with the MCB Camp Pendleton, and project economics would need to be resolved.

Both Management Alternatives assume that new sediment from outside the littoral cell will come from opportunistic programs or from offshore sand dredging. One alternative considers nourishment only, while the other alternative considers nourishment and installation of sediment management devices in order to retain more sediment over time. Both Alternatives are assumed to counteract effects of reduced natural sediment supplies (400,000 cubic yards per year), and to be adequate to achieve SANDAG's goal of increasing the amount of sediment in the region by 30 million cubic yards over 50 years (600,000 cubic yards per year).

Management Alternative One **–** Alternative One envisions an average placement rate of approximately 1,000,000 cubic yards of sediment per year on the region's beaches, and consists of two possible scenarios. Scenario One of Alternative One assumes that opportunistic beach fill programs are fully active and contribute approximately 800,000 cubic yards of sediment to the region. The balance of 200,000 cubic yards of sediment per year would be provided by larger-scale nourishment programs of SANDAG, the USACE, or both. These larger-scale projects would occur on a less frequent basis, such as every 5 to 10 years, and most likely consist of between 1,000,000 and 2,000,000 cubic yards of sediment, respectively. Scenario Two of Alternative One assumes that opportunistic beach fill programs contribute very little to no sediment throughout the region and the entire 1,000,000 cubic yards of sediment per year would be provided by larger-scale nourishment programs of SANDAG, the USACE, or both. These larger-scale projects would likely occur every 5 to 10 years and consist of between 5,000,000 and 10,000,000 cubic yards of sediment each.

Management Alternative Two **-** Alternative Two incorporates placement of sediment management devices at appropriate locations throughout the San Diego region, and envisions an average placement rate of approximately 500,000 cubic yards of sediment per year on the region's beaches under two scenarios. This approach is expected to reach SANDAG's 30 million cubic yard goal quicker than Alternative One. Sediment management devices are assumed to reduce the need for nourishment by 50 percent. Alternative Two also assumes that sediment losses are significantly reduced or eliminated, and therefore nearly the entire annual nourishment volume would go toward meeting the 30 million cubic yard regional target for additional sediment. This assumption would need to be verified during the technical feasibility analyses. Impacts at the downcoast end of the littoral cell associated with sediment being retained upcoast would need to be assessed, but are anticipated to be addressed by nourishment downcoast of management devices.

SANDAG (2007a) recently estimated the feasibility of sediment management devices and concluded that their use would reduce long-term costs by approximately 25 percent. SANDAG is currently developing a modeling study scope to further assess the effectiveness of sediment management devices. Scenario One of Alternative Two assumes that all opportunistic beach fill programs are fully active and contribute approximately 800,000 cubic yards of sediment per year (more than the quantity needed). Scenario Two assumes between 2,500,000 and 5,000,000 cubic yards of offshore sediment would be provided for nourishment by SANDAG, the USACE, or both every 5 to 10 years.

Project economics for use of offshore sediment are favorable for both Alternatives, with an estimated benefit-to-cost (B/C) ratio higher than 1.0. The B/C ratio is less than 1.0 for using opportunistic sediment due to the high costs of delivering sediment to the beach. Projects should therefore focus on using offshore sediment until cost reductions for use of upland sediment or additional funding sources can be realized.

Proportional Placement of Maintenance-Dredged Materials has the potential to help increase the residence time of placed sediments on the beaches and nearshore. Existing practices call for placement of certain sediment proportions dredged from lagoons and harbors upcoast rather than downcoast. In proportional placement the sediment would be placed primarily downcoast of the dredge site to reduce return shoaling in the source lagoon/harbor, if other conditions do not require its placement at an upcoast site.

Wetland Restoration **-** Sediment deposited in protected and low energy aquatic environments, such as closed (or not yet restored) lagoons, represents new sediment that can be added to the littoral zone to offset losses to the region. Sediment from wetland restoration projects will be relatively poorly-sorted and may consist of alternating layers of sandy and finer-grained sediment. This material could therefore potentially possess contaminants in the finer-grained layers. Several lagoons in the San Diego region are proposed for restoration, generating sediment can supplant that need from other sources (e.g., upland, offshore) to meet SANDAG's goal for new sand added to the region's beaches.

Bypassing of sediment from upcoast of Oceanside Harbor is recommended to increase sediment volumes along North County beaches. Oceanside Harbor jetty retains a wide sandy fillet formation extending several miles north of the jetty into MCB Camp Pendleton (DBW/ SANDAG 1994). This material would have naturally migrated to the southern portion of the Oceanside littoral cell had the jetty not halted its migration. Therefore, it represents an anthropogenic sediment sink, and restoration of natural littoral cell dynamics could provide a large-scale source of "new" sediment for the southern littoral cell. Sediment bypassing from this fillet represents one, if not the most potentially productive contributions to the coastal sediment budget for the San Diego region. SANDAG investigated this potential source in late 2008 and found it suitable for nourishment, but concluded that additional investigation is needed to better define the highest quality portions of the deposit.

Vision For The Future

SANDAG's vision for the future includes beach nourishment as the means to maintain the quality of life, protect and restore habitat, and reduce economic losses from reduced tourism or storm damage. It is important to implement nourishment-related activities in a cost-effective,

resource-protective, and politically acceptable manner. Offshore sediment represents the most economical source, which can be augmented by upland and wetland restoration sediments if and when they become available. Proportional placement of harbor and lagoon dredging materials could increase the residence time of sediment on nearby beaches. Restoration of sediment movement past the Oceanside Harbor jetty would contribute significantly to the region's sediment budget. Implementation of sediment management devices to retain sand along the coastline should be investigated in an iterative process. A technical feasibility analysis needs to verify assumptions in Management Alternative Two, and any sediment management device determined as feasible for a given location needs further assessment for environmental impacts and political acceptability.

Funding Sources

A dedicated source of funding is highly desirable if this regional program is to be successful. Incremental costs associated with longer transport distances, additional handling, or other efforts associated with regional sediment management need to be covered. There are a number of possible local and regional sources that could potentially help cover funding requirements of the recommended solutions for addressing sediment deficits in the San Diego region presented within this Plan. These funding sources include both existing and newly created funding sources. Existing funding sources include the state Ocean Protection Council, California Coastal Conservancy, and the California Coastal Commission mitigation funds currently administered by SANDAG. New potential funding sources include user fees such as rental car fees and parking fees at the municipal beaches, as well as additional sales taxes, development impact fees, property tax assessments, and transient occupancy tax increases. Each of these mechanisms can generate additional revenue for implementing Plan activities, and more than one source may be needed at any one time to render the proposed actions viable. A more detailed analysis of potential funding sources should be conducted in the future to determine the optimum mixture of revenue streams and to prepare a strategy for pursuit of those potential funding sources.

Permitting Requirements

Implementing the Coastal RSM Plan will require permits from several agencies, including the USACE (Section 404, 106 and 10 permits), California Coastal Commission (Coastal Development Permit or Consistency Determination), State Lands Commission (Lease), Regional Water Quality Control Board (Section 401 certification), and potentially the California State Parks (Encroachment Permit) and Department of Fish and Game (Streambed Alteration Agreement), depending on location. Local agencies also will require other permits such as grading permits, Coastal Development Permits (if authorized), and variances to applicable ordinances. The most expeditious manner to implement this Coastal RSM Plan would be to secure general permits from all agencies to streamline regulatory compliance.

Similar to opportunistic beach fill programs, general permits (or RGPs, such as existing RGP 67 of the USACE, Los Angeles District) could be established to provide advance approval in concept of beach fill meeting certain criteria. These approvals would require additional notification prior to each placement to confirm the quality of the fill and operations of the project. The USACE Los Angeles District Regulatory Branch is currently processing a number of 5-year or 10-year permits at many of the potential sediment sources and receiver sites discussed above. Most of these permits are directly applicable to comprehensive sediment

management as intended by the concept of regional sediment management. Binding these permits together under the auspices of the Coastal RSM Plan program could provide the basis for a general USACE permit covering the permitted locations.

Compliance with the California Environmental Quality Act (CEQA) and National Environmental Protection Act (NEPA) will be required for all projects conducted as part of the regional sediment management program. Those efforts will necessarily focus on the potential adverse impacts associated with activities in the region. Although the CRSM Plan is exempt from CEQA and NEPA for adoption, a Programmatic Environmental Impact Report/Environmental Impact Statement (PEIR/EIS) may be an appropriate document to secure permits for individual actions. Preparation of the PEIR/EIS is recommended as a future task for the permit approvals.

Governance Structure and Implementation

Adoption of this Coastal RSM Plan by SANDAG is the first step towards a more coordinated approach to regional sediment management. This Plan is to act as a reference, providing guidance for those wanting to implement sediment management activities throughout the San Diego region. SANDAG is best positioned to maintain the regional perspective needed to coordinate the various activities identified in this section and ensure that the Plan's goals and objectives are met. Integration of the Plan into CEQA Guidelines, the California Coastal Act, Local Coastal Programs, Local Zoning Ordinances, General Plans, and local permit processing are recommended means to enhance the effectiveness of the Plan and ensure its use for future sediment management activities. These efforts would be focused on requiring project proponents to address consistency with the Plan for projects within the coastal zone, or justify why compliance with the Plan is not feasible.

Other means are recommended to better provide for Plan utilization. A "Sandshed/Littoral Cell" Planning entity could be created to proactively research and identify sediment that is compatible and could be contributed to the coast, and to coordinate with watershed and other groups for the re-use of sediment to maximize compliance with the Plan. Reducing project fees when nourishment contributions are made could create economic incentives for developers to comply with the Plan. Finally, establishment of a general permit program that could streamline environmental review and permit approval by all agencies represents an effective way to implement the Coastal RSM Plan.

Coordinate with State Regulatory Programs

California has important regulatory efforts directed at coastal resource protection that could potentially limit the effectiveness of regional sediment management and implementation of the recommendations contained within this Coastal RSM Plan. SANDAG, the CSMW, and other stakeholders have and should continue to work with agency staff involved in these important efforts to highlight needs and identify mutual goals and objectives so that all these important efforts can succeed.

The Marine Life Protection Act (MLPA) initiative determines the sensitivity of offshore areas throughout California, including the San Diego region. Marine Protected Area (MPA) designations have the potential to inhibit the dredging of offshore sources and placement of sediment or sediment management devices on the beach and nearshore. The Coastal RSM Plan

and MLPA need to be integrated to meet the needs of both programs. Meeting mutual needs could be accomplished through coordination and information sharing between the groups leading these efforts, and developing respective plans consistent with the constraints of the other program. SANDAG and local cities will work within MPA designations to identify locations for future sediment management activities and conduct nourishment in an environmentally sensitive manner.

Future Total Maximum Daily Load (TMDL) regulations for sediment being set by the Regional Water Quality Control Board (RWQCB) have the potential to further reduce delivery of beach-compatible sediment to the coast. SANDAG and the SPWG should continue to actively work with the RWQCB to find ways to differentiate between coarse and fine sediment and to allow for the transport of sandy sediment to the coast when developing TMDLs and permitting sediment detention basins.

Monitoring

SANDAG's existing monitoring program is successful at quantifying shoreline changes and habitat conditions for actions spawned from the SPS (1993). That monitoring program can be modified or optimized for recommended RSM Plan projects. Monitoring and reporting that builds on current efforts will be required to assess biota, beach profiles, and lagoon shoaling in order to verify potential impacts and refine the Coastal RSM Plan. Monitoring results will be incorporated into this Coastal RSM Plan to optimize it and improve its effectiveness through adaptive management.

Data Gaps

Existing data gaps need to be filled to implement the Plan. For permitting, sediment gradation data for several Coastal RSM Plan beaches is needed to establish appropriate grain size envelopes for receiver sites. Additionally, more complete and updated sediment source information is needed throughout the region so that a standardized inventory/repository of data can be prepared for targeting promising opportunities for sediment placement.

Additional analyses also are needed for implementation and are listed below.

- The effects of appropriate sediment management devices on reducing future nourishment quantities, the time-frame to accomplish the 30 million cubic yard goal for the region, and the ability to adjust to sea level rise need to be determined;
- Appropriate proportional placement scenarios for lagoon and harbor maintenance need to be developed through evaluation of the most recent longshore sediment transport data from SIO's Coastal Data Information Program (CDIP);
- Quantification of the risk to sensitive hard-bottom areas from sedimentation relative to sediment placement volume or frequency is necessary;
- SIO needs to refine their lagoon subcell hypothesis;
- Continued evaluation of potential offshore sources of sediment through sampling, multi-beam bathymetry (backscatter), and seismic reflection/refraction profiling must occur;

- Estimation of environmental habitat benefits expressed as dollars for future benefit/cost analyses would be helpful for state grant funding; and
- Evaluation of actual project performance as compared to model predictions will improve the models for future use.

Recommended Next Steps

Short- and long-term actions that can be coordinated through SANDAG's SPWG to initiate Plan recommendations are listed in Section 11 and summarized below:

Short-Term

- Work with local agency staff to communicate the need for and benefits of the Coastal RSM Plan and develop strategies for them to integrate it within their jurisdictional authorities. Recommended efforts include: 1) confirm that proposed BECA sites are acceptable; 2) explore interest in sediment management devices; 3) acquire sediment gradation data for receiver sites not sampled since 2005; 4) update list of possible sediment sources; and 5) assess possible stockpile locations.
- Continue working within the MLPA initiative process to inform policy and decision-makers of the need for and benefits of nourishment, and with the San Diego RWQCB to consider transport of sediment to the coast when developing TMDLs and permitting sediment detention basins.
- Update the Shoreline Preservation Strategy to include new information from the Regional Beach Sand Projects, and advances in science and technology since its adoption.
- Coordinate with each watershed manager to facilitate continued coastal sediment yield.
- Incorporate inland aggregate and sediment mining information.

Long-Term

- Establish a "sandshed" authority to coordinate sediment availability and include their participation on the SPWG.
- Prepare a programmatic CEQA/NEPA document for implementation of certain RSM Plan actions.
- Conduct a study to determine the feasibility of installing off-loading sites, where appropriate, as part of any railroad double-tracking project to facilitate transport by rail.
- Integrate longshore sediment transport estimates from the SIO wave measuring program and incorporate lagoon subcells as appropriate.
- Take a systematic approach to local agency implementation when projects are applied for, with city staff or the sandshed authority performing the initial evaluation for candidacy.
- Establish one or several general permits from all agencies for all unpermitted sites.

- Assess the feasibility of sediment management devices, determine their optimum locations and designs, obtain funding, and install if and as appropriate.
- Implement action steps at each city such as:
    - Identify opportunistic sediment during project processing;
    - Identify funding sources (or incentives) to implement opportunistic projects;
    - Perform opportunistic beach fill projects (and monitoring);
    - Amend LCPs and General Plans as needed to be consistent with the Coastal RSM Plan; and
    - Install any needed infrastructure to enable sediment delivery (e.g., ramps to the beach).
- Establish optimized monitoring procedures for this CRSM Plan as an extension from existing monitoring, and implement strategic monitoring to support decision-making relative to adaptive management (e.g., optimizing sediment placement volumes or frequency in areas with sensitive resources) on a regional level.
- Create a secure funding stream by establishing a funding strategy, including linkage of watershed and sediment management planning in order to leverage federal and state funding.
- Assess the feasibility of imposing a fee on dam owners that impound sediment upstream of the coast.
- Utilize data from pilot projects such as the Tijuana Estuary Sediment Fate and Transport Science Study to update this Coastal RSM Plan.

Updates and Disclaimer

This Coastal RSM Plan should be considered a "living" document that is periodically updated based on new information, monitoring results, and filling of data gaps to optimize and adaptively manage sediment around the region. SANDAG may need to reconsider the Coastal RSM Plan elements on a five- to ten-year basis to keep the plan current and to coordinate information presented in this Plan and the Shoreline Preservation Strategy.

Funding for this project was provided to SANDAG by a California Department of Boating and Waterways grant on behalf of CSMW's efforts related to implementation of their Coastal Sediment Master Plan. SANDAG has utilized the funding to develop findings and recommendations consistent with local issues and needs, and the CSMW has participated in an advisory role to help maintain consistency with similar projects elsewhere in coastal California.
Recommendations are presented in this report solely for consideration by government agencies, organizations, and committees involved in the management and protection of coastal resources in the San Diego Region. This document was prepared with significant input from CSMW members but does not necessarily represent the official position of any CSMW member agency.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 BACKGROUND 6
1.1.1 Coastal Processes Summary 6
1.1.2 Sediment Deficits and RSM Solutions 8
1.1.3 Coordination 10
1.1.4 Challenges 10
1.2 GOALS 11
1.2.1 Consensus-Driven Regional Sediment Management Guidance and Policy 11
1.2.2 Adoption of the Plan 11
1.2.3 Meet SANDAG's Future "Quality of Life" 12
1.2.4 Sea Level Rise 14
1.3 REPORT ORGANIZATION 14
1.4 DEFINITIONS 15

2.0 SCOPE OF WORK 18

2.1 DEVELOP THE COASTAL RSM PLAN AND RSM TOOLS 18
2.2 PERFORM PUBLIC OUTREACH 18
2.3 RECOMMEND A GOVERNANCE STRUCTURE THAT WILL EFFECTIVELY SUPPORT IMPLEMENTATION OF THE PLAN 18
2.4 PREPARE THE DRAFT AND FINAL PLAN 19

3.0 COASTAL PROCESSES 21

3.1 SEDIMENT BUDGETS AND LONGSHORE SEDIMENT TRANSPORT RATES 21
3.1.1 Oceanside Littoral Cell 22
3.1.2 Mission Bay Littoral Cell 23
3.1.3 Silver Strand Littoral Cell 23
3.2 WAVE CLIMATE 24
3.2.1 Wave Sources 24
3.3 THEORETICAL SUBCELLS WITHIN THE SAN DIEGO NORTH COUNTY REGION 25

4.0 POTENTIAL COASTAL RECEIVER AREAS 28

4.1 BEACH EROSION SITES 28
4.1.1 State Beach Erosion Concern Areas 29
4.1.2 SANDAG Shoreline Erosion Problem Areas 31
4.2 BEACH PROFILES 31
4.3 EXISTING COASTAL SEDIMENT QUALITY 38
4.3.1 Grain Size Homogeneity 39
4.3.2 Grain Size Range 39
4.3.3 Sediment Color 40
4.4 EXISTING COASTAL HABITAT CONSTRAINTS 40
4.4.1 Overview of Coastal Habitats 40
4.4.2 Summary of Biota Constraints 41
4.4.3 Biota Impact Considerations 52

5.0 SEDIMENT SOURCES 63

5.1 LOCATIONS – UPLAND, COASTAL, AND OFFSHORE 67
5.1.1 Upland Sources 67
5.1.2 Coastal - Lagoons and Harbors 67
5.1.3 Offshore Sources 71
5.2 QUANTITIES 73
5.2.1 Upland Quantities 73
5.2.2 Lagoon and Harbor Quantities 74
5.2.3 Offshore Quantities 74

5.3 QUALITIES 74
5.3.1 Upland Sediment Quality 74
5.3.2 Lagoon and Harbor Quality 75
5.3.3 Offshore Ocean Quality 75
5.4 OWNERSHIP 76
5.4.1 Upland Ownership 76
5.4.2 Lagoon and Harbor Ownership 76
5.4.3 Offshore Ocean Ownership 76
5.5 TIMEFRAME OF MATERIAL AVAILABILITY 76
5.6 CONTACT PERSON AND INFORMATION 77
5.7 GIS DATA LAYERS 77

6.0 SEDIMENT MANAGEMENT APPROACH FOR VARIOUS CATEGORIES OF SEDIMENT SOURCES 78

6.1 UPLAND SEDIMENT 78
6.1.1 Availability and Timing 79
6.1.2 Transportation 79
6.1.3 Receiver Sites 79
6.1.4 Habitat Considerations 87
6.1.5 Placement Designs and Restrictions 89
6.1.6 Stockpiling 89
6.2 LAGOON RESTORATION, AND LAGOON AND HARBOR MAINTENANCE 91
6.2.1 Availability and Timing 92
6.2.2 Transportation 93
6.2.3 Receiver Sites with Proportional Placement 93
6.2.4 Habitat Considerations 101
6.2.5 Receiver Sites Without Proportional Placement 102
6.2.6 Habitat Considerations 104
6.2.7 Placement Designs 104
6.3 OFFSHORE SEDIMENT 104
6.3.1 Availability and Timing 105
6.3.2 Transportation 106
6.3.3 Receiver Sites for Offshore Sand 106
6.3.4 Habitat Considerations 110
6.4 BYPASSING OF OFFSHORE SAND FROM MARINE CORPS BASE CAMP PENDLETON 111
6.4.1 Availability and Timing 112
6.4.2 Transportation 112
6.4.3 Receiver Sites 113
6.4.4 Timing of Nourishment 114
6.4.5 Habitat Considerations 114
6.5 ALL SOURCES OR A COMBINATION OF SOURCES 114
6.5.1 Receiver Sites 115
6.5.2 Timing of Nourishment 122
6.5.3 Habitat Considerations 122

7.0 SOLUTIONS 124

7.1 ALTERNATIVE 1- ONE MILLION CUBIC YARDS PER YEAR WITHOUT SEDIMENT MANAGEMENT DEVICES 128
7.1.1 Scenario 1 - Sediment from Upland Sources and From Offshore Dredging 128
7.1.2 Scenario 2 - Offshore Dredging Alone 130
7.1.3 Summary of Performance Without Sediment Management Devices 131
7.1.4 Habitat Considerations 131
7.2 ALTERNATIVE 2 - ONE HALF MILLION CUBIC YARDS OF SEDIMENT PER YEAR WITH SEDIMENT MANAGEMENT DEVICES 132
7.2.1 Scenario 3 - Sediment Management Devices at Appropriate Sites With All Sediment From Upland Beach Fill 132
7.2.2 Scenario 4 - Sediment Management Devices with Sediment from Offshore Dredging 132

7.2.3 Summary of Performance with Sediment Management Devices *133*
7.2.4 Habitat Considerations *133*
7.3 RECOMMENDED PLAN 133

8.0 ADDITIONAL CONSIDERATIONS OF ALTERNATIVES 135

8.1 ECONOMIC FEASIBILITY 135
8.2 PROGRAM COSTS 135
8.3 PROGRAM BENEFITS 136
8.4 POSSIBLE FUNDING SOURCES 137
8.4.1 Regional Sales Tax *137*
8.4.2 Rental Car Fees *137*
8.4.3 Transient Occupancy Tax *137*
8.4.4 Property Tax Assessments *138*
8.4.5 Parking Fees *138*
8.4.6 Development Impact Fees *138*
8.4.7 Inland Sediment Transport Offset Fund *138*
8.5 PERMITTING REQUIREMENTS 140
8.6 EXISTING PERMITS 141

9.0 GOVERNANCE STRUCTURE AND IMPLEMENTATION 142

9.1 IMPLEMENTATION OPTIONS FOR GOVERNANCE STRUCTURE 142
9.1.1 Add to/Amend CEQA Initial Study Checklist *142*
9.1.2 Rely on the California Coastal Act *143*
9.1.3 Add to/Amend Local Coastal Programs *143*
9.1.4 City/County Grading Permits *143*
9.1.5 Incentives Through Reduced Developer Fees *144*
9.1.6 Local Zoning Ordinances and General Plans *144*
9.1.7 Establish "Sandsheds/Littoral Cell" Planning Agencies *144*
9.1.8 General Permits *144*
9.1.9 Environmental Review *145*
9.1.10 Coordinate with State Regulatory Programs *146*
9.2 POSSIBLE CHALLENGES TO IMPLEMENTATION 147

10.0 MONITORING AND REPORTING 149

10.1 IMPACT ASSESSMENT AND PERFORMANCE EVALUATION 149
10.2 ADAPTIVE MANAGEMENT 151

11.0 DATA GAPS AND RECOMMENDED NEXT STEPS 152

11.1 DATA GAPS AND NEEDED ANALYSES 152
11.2 RECOMMENDED NEXT STEPS – SHORT- AND LONG-TERM 153

12.0 CONCLUSIONS 155

13.0 REFERENCES 158

Appendices

A. Other Relevant Coastal References and Sediment Information
B. Public Workshop Attendance Lists and Contact Information
C. Sand Gradation Curves for San Diego Region Beaches
D. Cost Estimates and Benefit/Cost Matrices
E. Coastal Marine Habitat Data

Separate Related Data (Electronic Form)

F. Coastal Sediment Metadata
G. Source Sediment Metadata
H. Coastal Marine Habitat Metadata
I. List of GIS Shapefiles Provided to the CSMW

LIST OF TABLES

Table 1 – Coastal Sediment Deficits in the San Diego Region from the SPS

Table 2 – Beach Erosion Concern Areas Compiled by the CSMW

Table 3 – Beach Profile Data for Representative Beaches

Table 4 – Regional Distribution of Habitats in San Diego County

Table 5 – Sensitive Biota Near Sediment Management Receiver Sites

Table 6 – Existing Sediment Sources

Table 7 – Typical Quantities and Timing of Existing Sediment Sources

Table 8 – Estimated Annual Quantities of Sediment from Maintenance Dredging/Excavation

Table 9 – Periodic Quantities of Sediment from Wetland Restoration Activities

Table 10 – Proportional Placement of Sediment from Local Dredge Projects

Table 11 – Non-Proportional Placement of Sediment from Local Dredge Projects

Table 12 – Coastal RSM Plan Receiver Sites for All Sediment Sources

Table 13 – Approximate Planned and Actual Sediment Placement Quantities, North County San Diego from 1993 to 2015

Table 14 – Approximate Planned and Actual Sediment Placement Quantities, South County San Diego from 1993 to 2015

Table 15 – Approximate Planned and Actual Sediment Placement Quantities, Central County San Diego from 1993 to 2015

Table 16 – Maximum Existing and Future Upland Beach Fill Program Quantities

Table 17 – Possible Quantities for the Scenario of Upland and Offshore Sediment Combined

Table 18 – Annualized Costs and Benefits of RSM Alternatives

Table 19 – Overview of Monitoring Program

LIST OF FIGURES

Figure 1 – The San Diego Coastal RSM Plan Region

Figure 2 – Existing Sediment Management Practices

Figure 3 – Examples of Proactive Sediment Management

Figure 4 – Littoral Cells Within San Diego County

Figure 5 – Wave Exposure Diagram

Figure 6 – Wave-Driven Lagoon Sub-Cells

Figure 7 – State of California Beach Erosion Concern Areas

Figure 8 – SANDAG Shoreline Erosion Problem Areas

Figure 9 – Beach Profile Locations (North County)

Figure 10 – Beach Profile Locations (Central and South County)

Figure 11 – Beach Profiles for Moonlight Beach (North County)

Figure 12 – Beach Profiles for Mission Beach (Central County)

Figure 13 – Beach Profiles for Imperial Beach (South County)

Figure 14 – Sensitive Biological Resource Areas in the Vicinity of Oceanside Sediment Management Areas.

Figure 15 – Sensitive Biological Resource Areas in the Vicinity of Carlsbad Sediment Management Areas

Figure 16 – Sensitive Biological Resource Areas in the Vicinity of Carlsbad and Encinitas Sediment Management Areas

Figure 17 – Sensitive Biological Resource Areas in the Vicinity of Encinitas and Solana Beach Sediment Management Areas

Figure 18 – Sensitive Biological Resource Areas in the Vicinity of Del Mar and Torrey Pines Sediment Management Areas

Figure 19 – Sensitive Biological Resource Areas in the Vicinity of Mission Beach Sediment Management Areas

Figure 20 – Sensitive Biological Resource Areas in the Vicinity of Coronado Sediment Management Areas

Figure 21 – Sensitive Biological Resource Areas in the Vicinity of Imperial Beach Sediment Management Areas

Figure 22 – Sediment Source Locations in the North County Region

Figure 23 – Sediment Source Locations in the South County Region

Figure 24 – Lagoons and Harbors in San Diego County

Figure 25 – Offshore Sediment Sources in San Diego County

LIST OF FIGURES *(cont.)*

Figure 26 – Regional Transport Routes in San Diego County
Figure 27 – North County Upland Sediment Receiver Sites
Figure 28 – Central County Upland Sediment Receiver Sites
Figure 29 – South Central County Upland Sediment Receiver Sites
Figure 30 – South County Upland Sediment Receiver Sites
Figure 31 – Examples of Potential Stockpile Locations
Figure 32 – Maintenance Dredging and Wetland Restoration (North County)
Figure 33 – Maintenance Dredging and Wetland Restoration (North Central County)
Figure 34 – Maintenance Dredging and Wetland Restoration (Central County)
Figure 35 – Maintenance Dredging and Wetland Restoration (South Central County)
Figure 36 – Maintenance Dredging and Wetland Restoration (South County)
Figure 37 – Offshore Sediment Receiver Sites (North County)
Figure 38 – Offshore Sediment Receiver Sites (Central County)
Figure 39 – Offshore Sediment Receiver Sites (South County)
Figure 40 – Oceanside Nearshore Sediment Bypassing Concept
Figure 41 – North County Regional Receiver Sites
Figure 42 – North Central County Regional Receiver Sites
Figure 43 – Central County Regional Receiver Sites
Figure 44 – South Central County Regional Receiver Sites
Figure 45 – South County Regional Receiver Sites

1.0

INTRODUCTION

The San Diego region (Figure 1) experiences severe coastal erosion. A Coastal Regional Sediment Management Plan (Coastal RSM Plan) is needed immediately to:

- Facilitate solutions to beach erosion affecting infrastructure, recreation, public safety, public coastal access, and habitat, and address sea level rise;
- Fulfill the statewide sediment management strategy of the California Coastal Sediment Management Workgroup (CSMW) within the region; and
- Enable the San Diego Association of Governments (SANDAG), to implement their vision and establish a process to address beach erosion through effective management of sediment resources throughout the region.

Communities within the San Diego region are committed to preserving and restoring their beaches for habitat, recreation, public safety, economic, and shore and property (infrastructure) protection benefits. SANDAG has worked with the State of California, the CSMW, and local agencies to prepare and adopt ongoing beach restoration strategies. These strategies include:

- Formulating the regional Shoreline Preservation Working Group of local political leaders, stakeholders, and interested citizens meeting bi-monthly;
- Developing the 1993 Shoreline Preservation Strategy (SPS), which recommends beach nourishment in the form of Regional Beach Sand Projects (RBSPs) done in 2001 (RBSP I) and planned for 2011 or 2012 (RBSP II);
- Partnering with the CSMW on regional sediment management planning by developing and implementing the Sand Compatibility and Opportunistic Use Program (SCOUP) versions I (at Oceanside) and II (at Encinitas, Solana Beach, Coronado, and Imperial Beach);
- Coordinating with the U.S. Army Corps of Engineers (USACE) by participating in three federal shore protection projects within the region (Encinitas/Solana Beach, Imperial Beach and North San Diego County); ;
- Creating local citizen committees concerned about the beaches at the Cities of Oceanside, Carlsbad, Encinitas, and Imperial Beach;
- Establishment of the Beach Sand Mitigation Fund and the Public Recreational Beach Impact Mitigation Fund with the California Coastal Commission; and
- Implementing individual sand projects to address beach preservation within certain cities.

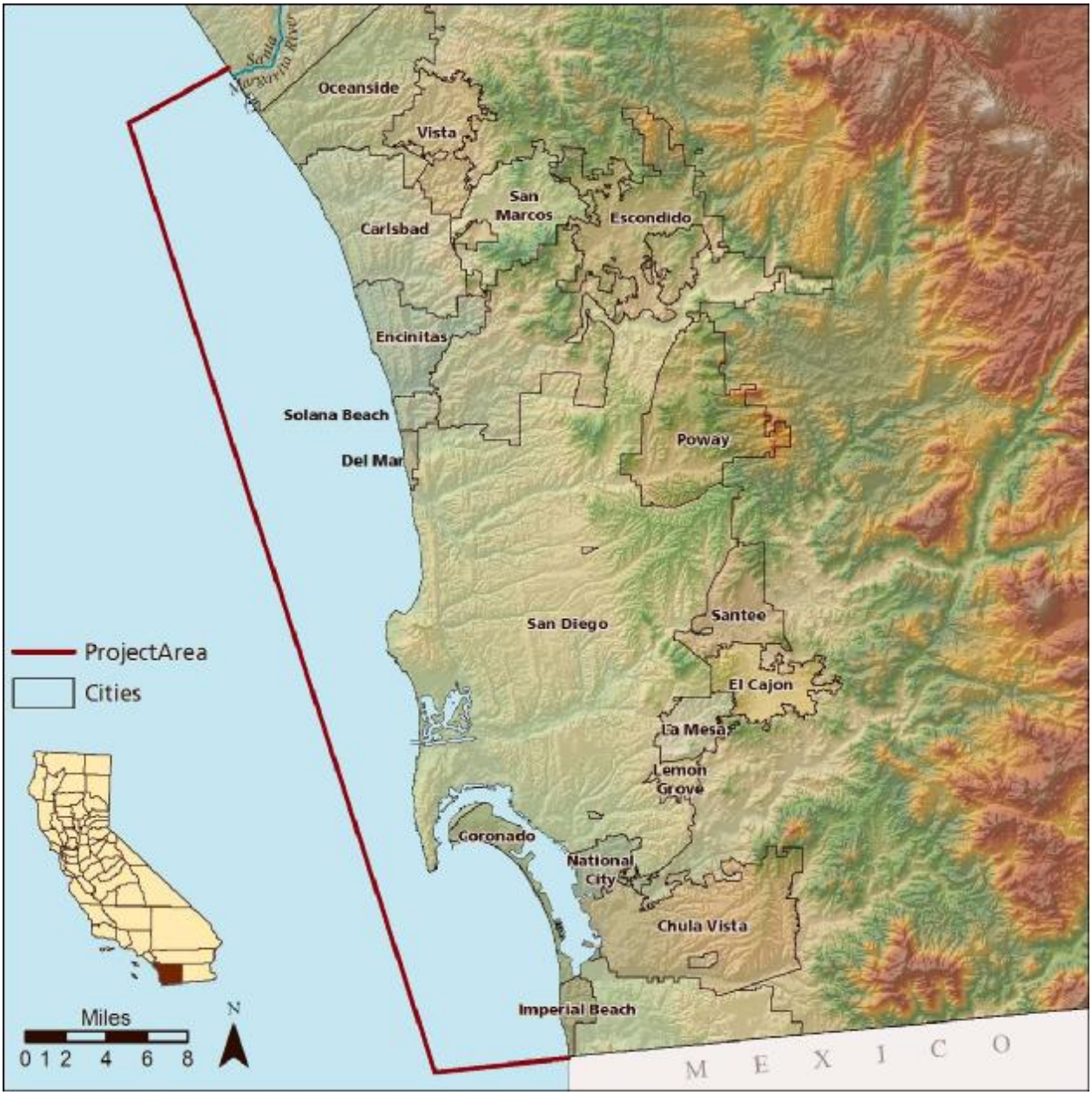


Figure 1 – The San Diego Coastal RSM Plan Region

Beaches require a continual, ongoing source of sand to maintain their width. Beach restoration is acutely needed in the San Diego region, due to ongoing large-scale (regional) beach erosion, degradation of sandy beach habitat, bluff failure and collapse, loss of life and public and private property, and proliferation of hard structures throughout the region. Loss of sand from the region's beaches has occurred continually since:

- Implementation of flood control and other infrastructure throughout the coastal watersheds that reduces supply of sand from rivers;

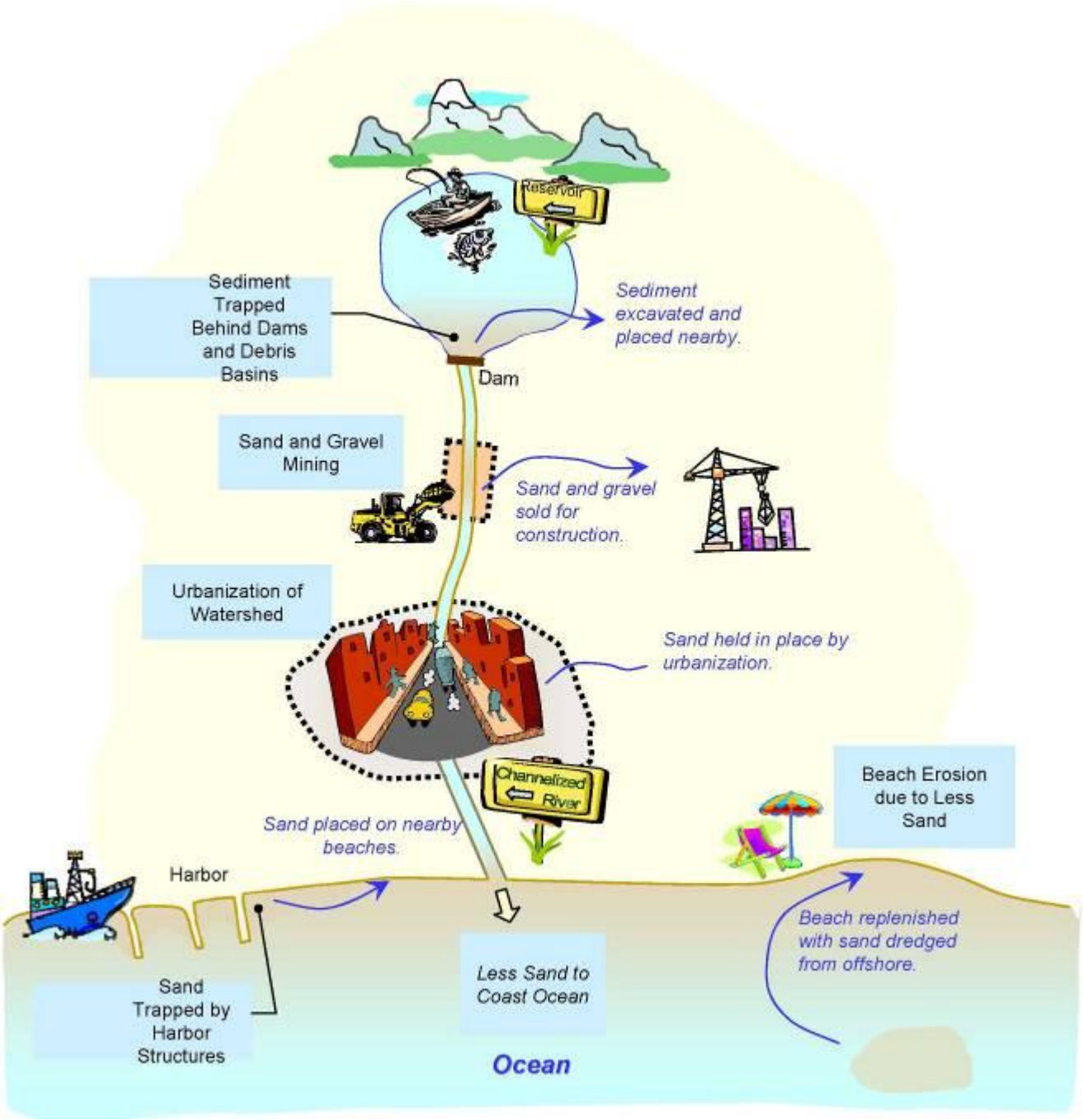
- Construction of Oceanside Harbor in the early 1960s (which added sand to the region over the short-term, but significantly interrupted sand delivery from upcoast over the long-term);
- Proliferation of hard structures (e.g., seawalls) that prevent bluff sand from being deposited on the beach;
- Natural change to a more energetic wave climate since 1978;
- Reduced rates of beach nourishment since the 1960's; and
- Dense urbanization in the coastal zone.

Researchers indicate an annual loss of sand occurs at beaches in all geographic areas within the San Diego County region (U.S. Army Corps of Engineers 1990 and 1991; California Department of Boating and Waterways/SANDAG 1994; Patsch and Griggs 2006). As such, the volume of sediment in the coastal zone is significantly depleted from historic natural conditions.

A coastal sediment management budget by Inman and Frautschy (1965) is a concept showing how the path of sand to, along, and away from the coast is affected by human actions. It reveals an historic lack of understanding, mis-management, and can serve as a tool to enable improved and effective management. Under recent historic conditions, sediment management in the San Diego region has not been intentionally performed to maintain sand delivery to and along the coast. As such, sediment volumes in the region are decreasing and beaches are narrowing. A conceptual example of historical/existing coastal regional sediment management (or non-management) in a region is shown in Figure 2.

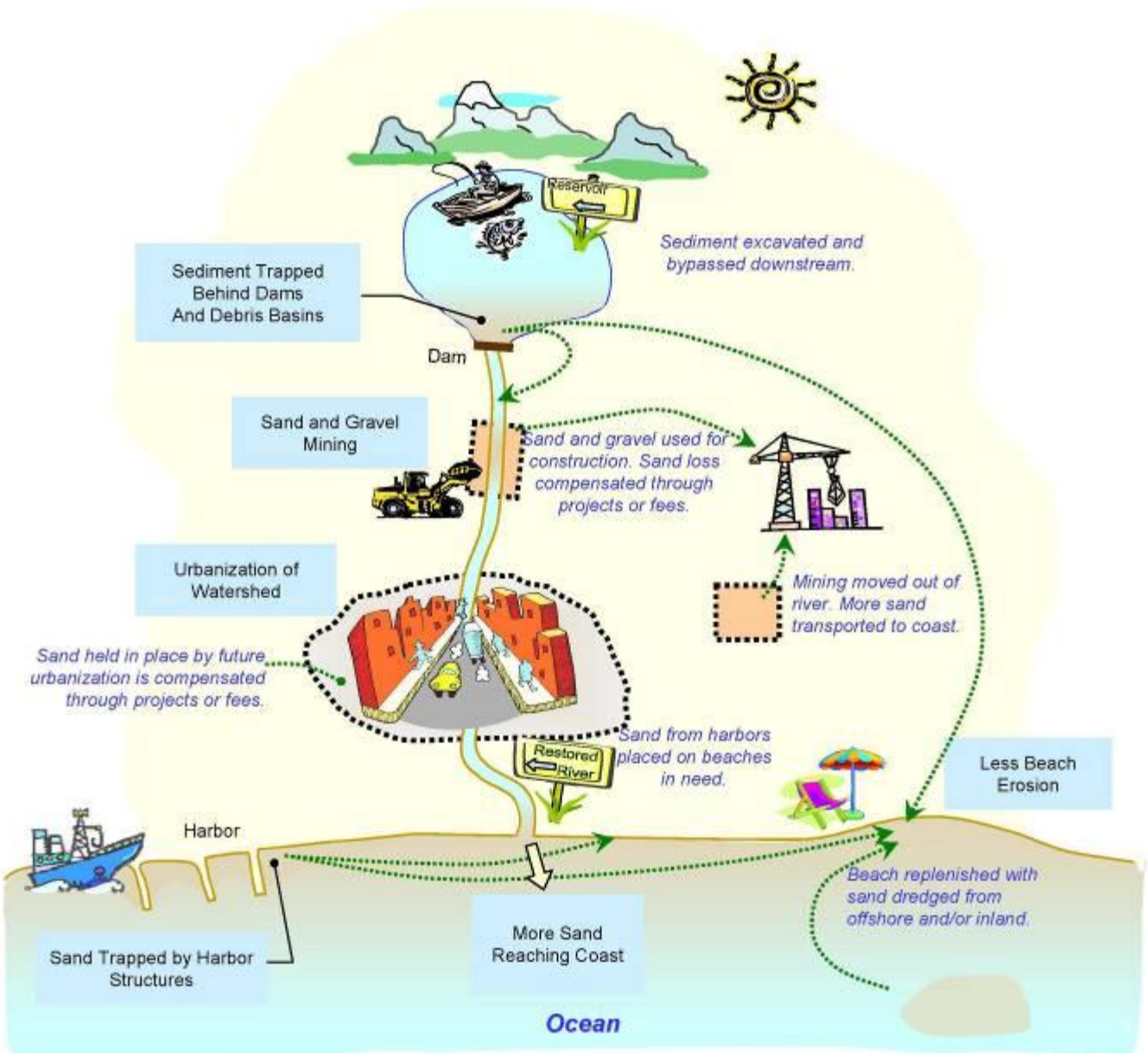
In contrast, coastal regional sediment management can be modified and become proactive to address problems identified with existing practices. Figure 3 shows a conceptual example of effective coastal regional sediment management. The major difference between the sediment management shown in Figures 2 and 3 is that sediment delivery to the coast from upland and along the coast is restored and maintained under proactive regional sediment management, thus addressing problems at critical erosion areas.

Coastal regional sediment management is defined as beneficial reuse of surplus sediment found anywhere within coastal watersheds and littoral cells that could be used to offset coastal erosion. This Coastal RSM Plan is a comprehensive guidance and policy document presenting regional sediment management in an expeditious, cost-effective, and resource-protective manner for the San Diego region.



Source: CSMW's Sediment Management Plan Brochure (www.dbw.ca.gov/csmw/default.aspx)

Figure 2 – Existing Sediment Management Practices



Source: CSMWs Sediment Management Plan Brochure (www.dbw.ca.gov/csmw/default.aspx)

Figure 3 – Examples of Proactive Sediment Management

1.1 Background

Background information addressing the need for regional sediment management in the San Diego region is provided below.

1.1.1 Coastal Processes Summary

Coastal processes drive the movement of littoral sediment, leading to beach erosion, beach stability, or beach accretion. A brief background of coastal processes in San Diego County is presented in this section and more detail is provided in Section 3.0 of this report.

The coast can be separated into distinct geographic areas called littoral cells. Littoral cells are the areas where sediment enters, moves along, and leaves the coast, and they are bounded by physiographic features (e.g., submarine canyons, headlands) on their up- and downcoast ends. The littoral cells within San Diego County (Figure 4) are the Oceanside Littoral Cell (the southern subcell is south of Oceanside Harbor) to the north, the Mission Bay Littoral Cell in the center, and the Silver Strand Littoral Cell to the south. The concept of littoral cells was first identified by Inman and Frautschy (1965) and further discussed by Habel & Armstrong (1977).

Incoming waves produce nearshore currents that transport sediment both alongshore (parallel to) and across shore (to and away from shore) within the littoral cell. Sediment transport moves both to the north and south throughout the County. Gross sediment transport is the total additive rate of sediment movement in both directions, while net sediment transport is the difference between southward and northward movement. Generally, the net transport is from north to south in the Oceanside and Mission Bay Cells and from south to north in most of the Silver Strand Cell (with a split to the south at the Tijuana River delta).

Waves approach the San Diego County coast from all angles between south and northwest. The most powerful waves come from the west/northwest, thereby causing longshore currents to run toward the south the majority of the time. The major exception is in the Silver Strand Cell where approaching waves refract (bend) around the large bathymetric irregularities of Point Loma and the Tijuana River delta, to approach the South County shore at angles more from the southwest than west/northwest thereby producing net northward transport. Net littoral sediment transport south of the Tijuana River delta is to the south. A smaller-scale exception occurs just south of Oceanside harbor where waves refract around a shoal off the harbor entrance that produces a northward current north of the groin one-half mile south of the South Harbor Jetty.

The sediment budget is a concept allowing quantification of the relative balance of sediment inputs to and outputs from the littoral cell. The sediment budget indicates if the cell is losing sand (negative balance), gaining sand (positive balance), or is in equilibrium. A negative balance indicates that the cell is losing sand and the beaches are likely narrowing, while a positive balance indicates beaches are gaining sand and likely widening. The following sediment budget conditions have been documented within the San Diego Region:

- The southern Oceanside Littoral Cell loses nearly 60,000 cubic yards of sand per year (Patsch and Griggs 2006);

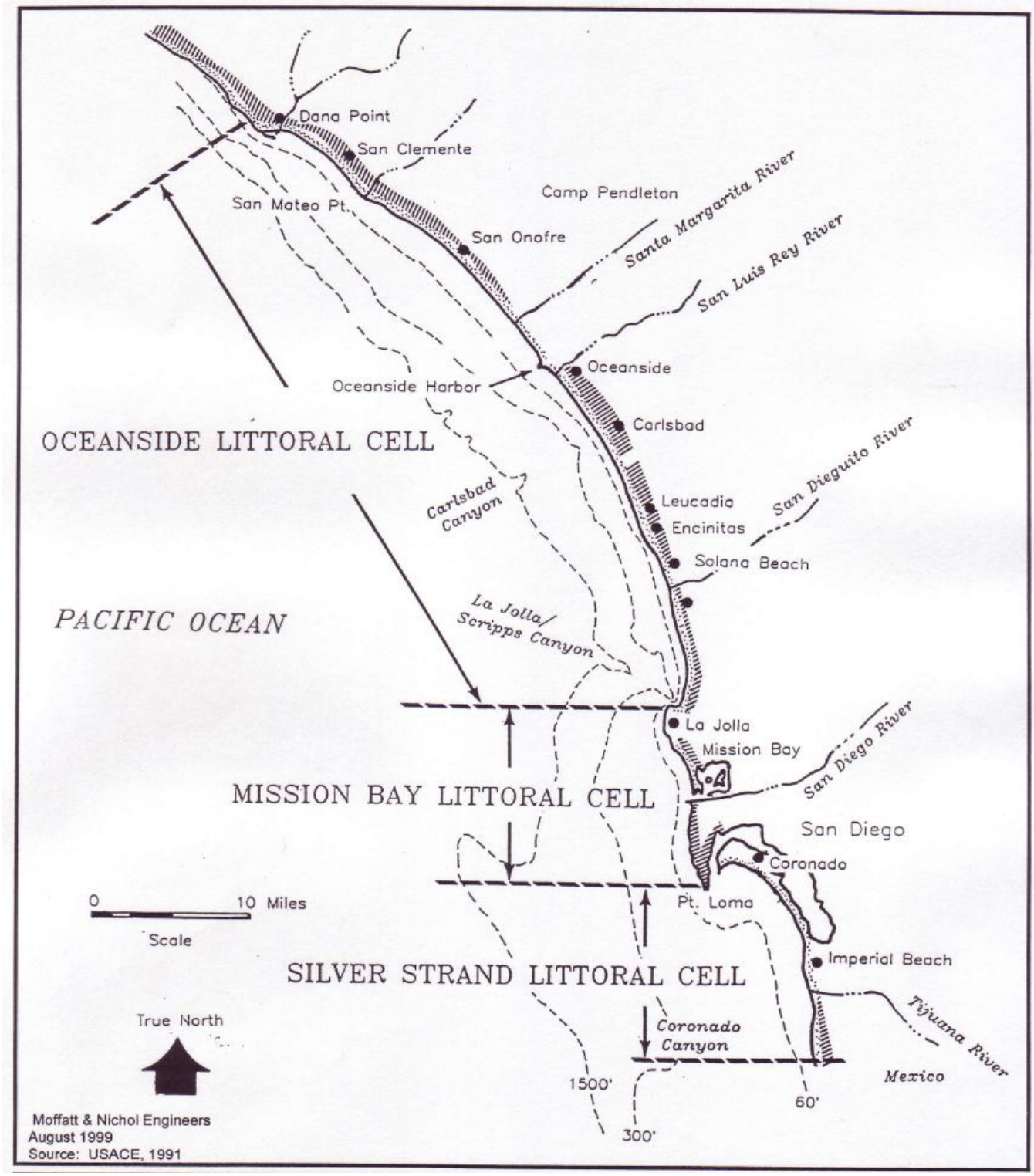


Figure 4 – Littoral Cells Within San Diego County

- The Mission Bay Littoral Cell either loses 10,000 cubic yards of sand per year along Mission Beach and 7,000 cubic yards of sand per year along Ocean Beach (USACE 1990 and 1991), or nearly 40,000 cubic yards of sand per year overall (Patsch and Griggs 2006); and
- The Silver Strand Littoral Cell loses 65,000 cubic yards of sand per year near the Tijuana River Delta and 40,000 cubic yards of sand per year along the Silver Strand Beach (USACE 1990 and 1991).

These reductions can be attributed to several factors, including loss of littoral sediment through alongshore transport to submarine canyons, as well as cross-shore transport during large storm events in which sands are deposited at depths beyond that where coastal processes could restore the sand to the coastline.

As a result of extensive study of the San Diego Region by the USACE (1990 and 1991), the SPS (SANDAG 1993) recommended beach widening in the region by adding fill quantities of up to approximately 30 million cubic yards of sand on the region's beaches as an initial restoration effort, followed by maintenance with approximately 400,000 cubic yards placed annually. Placement of up to 30 million cubic yards of sand on the beach at one time is likely to be infeasible from an environmental standpoint due to potential impacts to sensitive biological habitat, and would require significant funds. Therefore, placement of the sediment quantity recommended by the SPS will need to occur in multiple placement projects over years if not decades. The pilot RBSP I project in 2001 confirmed that 2.1 million cubic yards of sand could be placed at various sites without causing adverse environmental impacts. Subsequent RBSPs should consider placement of larger sand quantities and revisions to placement areas to determine the maximum sand placement quantity for a project while avoiding significant habitat impacts.

1.1.2
Sediment Deficits and RSM Solutions

San Diego County coastal areas experience sediment deficits from effects of Oceanside Harbor, inland flood control works, sediment detention basins, urban development, coastal bluff stabilization, lagoon and harbor sediment trapping, and active erosion. Deficits are unequal within the region and occur mainly in the northern and southern parts of the County, specifically the southern Oceanside littoral cell and near Imperial Beach in the Silver Strand cell. Table 1 shows the specific condition of the region's beaches and nourishment quantities needed to remedy the deficits according to the Shoreline Preservation Strategy (SANDAG 1993).

Table 1 - Coastal Sediment Deficits in the San Diego Region From the SPS

Littoral Cell	Sediment Budget Condition	Nourishment Quantity Needed for Restoration (cubic yards)	Nourishment Quantity Needed for Maintenance (cubic yards per year)
Southern Oceanside	Negative	25,000,000	320,000
Mission Bay	Equilibrium to slightly negative	500,000 to 6,200,000	5,000
Silver Strand	Negative	3,000,000	90,000
Region-wide	**Negative**	**28,500,000 to 34,200,000**	**415,000**

Source: SANDAG Shoreline Preservation Strategy 1993

Monitoring of the 2001 SANDAG RBSP I project showed a discernible "life span" of approximately four years for the 2.1 million cubic yard project. The firm that completed the monitoring program (Coastal Frontiers Corporation) indicates that by year five of post-project monitoring the widened beaches had reverted back to their narrower pre-project condition (personal communication, Greg Hearon, Coastal Frontiers 2008; Coastal Frontiers 2007). This observation suggests that approximately 400,000 cubic yards of sediment per year were lost from the region and/or dispersed so broadly that they could not be measured between 2002 and 2006 (roughly subdivided into 350,000 cubic yards per year from North County and 50,000 cubic yards per year from South County). These losses are consistent in magnitude with the maintenance renourishment rates recommended by SANDAG's SPS (1993).

Regional sediment management may help to solve the problem of insufficient sediment delivery to the coast, thus allowing more sediment to move along the coast. Surplus sediment at upland and coastal locations throughout the County can be a burden to owners with insufficient stockpile space or insufficient budgets for its proper disposal. Both upland sediment and sand in offshore deposits can serve to nourish denuded beaches as a public benefit. Adding sediment to the coast that is presently trapped upstream or upcoast, or sequestered in offshore and terrestrial sand deposits may be effective for offsetting existing sediment losses from the coastal zone. Removal of existing surplus sediment from impacted areas (e.g., clogged harbor entrances, lagoon mouths, degraded wetlands) can also benefit those areas by restoring site functions.

At a minimum, future nourishment rates should equal loss rates, and better would be nourishment rates that exceed the loss rates to promote beach widening. For example, adding 1 million cubic years of sand per year to the region could accomplish the targeted 30 million cubic yard gain in approximately 50 years or less (without any artificial sand retention), assuming that no increase in the existing sand loss rate occurs and the rate of sea level rise is only moderate rather than extreme. This rate should therefore serve as the target renourishment guideline for future inputs to the region. Sediment management devices used for sand retention such as offshore submerged reefs could reduce that target amount by an unknown amount. Sediment management devices can also be enhanced to ameliorate the effects of sea level rise on the loss of sediments from the coastline.

1.1.3
Coordination

Coordination is required among owners of surplus sediment and coastal communities to ensure that sediment is readily available for areas in need of nourishment. The entities within the San Diego region that need to be involved in coordinated coastal sediment management planning are SANDAG, the CSMW, resource agencies not included in the CSMW, the County, California State Parks, the coastal cities, and local stakeholders (local Watershed Planning Groups, Scripps Institution of Oceanography, lobster and other fishermen, the Surfrider Foundation, Homeowner Groups, City Beach Erosion Committees, and others). Existing management plans and projects that can be used to improve such coordination include the:

- Shoreline Preservation Strategy (SANDAG);
- SCOUP Plans I and II (SANDAG, CSMW, DBW, and the participating coastal Cities of Oceanside, Encinitas, Solana Beach, Coronado, and Imperial Beach);
- California Sediment Master Plan (CSMW);
- Opportunistic Beach Fill Programs (participating coastal cities derived from SCOUP Plans and Carlsbad);
- Regional General Permit 67 (USACE);
- California Coastal Act (Coastal Commission);
- Monitoring and Observation Programs (Scripps Institution of Oceanography); and
- SANDAG Regional Shoreline Monitoring Program and project-specific Regional Beach Sand Project monitoring..

In the San Diego region, an effective venue for coordination already exists in the form of the Shoreline Preservation Working Group (SPWG). This is a working group of SANDAG's Regional Planning Committee (RPC) that meets approximately bi-monthly. Its members consist of one elected representative from each coastal city and the County, staff of the Port of San Diego and the U.S. Navy, technical advisory members of appropriate resource agencies, and stakeholder groups. The SPWG is assisted by a working staff representative from each coastal city. The voting members of the SPWG (local elected officials and staff from the Port and Navy) make decisions regarding coastal issues within this region and forward recommendations to the RPC for consideration, with final action ultimately taken by the SANDAG Board of Directors. Coordination of issues and efforts for regional sediment management can occur at this working group setting.

1.1.4
Challenges

Challenges that have the potential to limit the effectiveness of regional sediment management exist and need to be considered. Such challenges include existing government policies, activities of stakeholder groups, and economic challenges of projects such as capital development projects, shore protection devices, etc. Often such potential challenges can be anticipated and potentially avoided or ameliorated to enable regional sediment management. More information regarding impediments to this concept is presented in Section 9.2 of this Plan.

1.2 Goals

Regional coastal sediment management is based on achieving multiple goals. Goals address renourishing the region's coast, while providing a beneficial reuse option for surplus sand suitable for placement within the coastal zone.

1.2.1
Consensus-Driven Regional Sediment Management Guidance and Policy

The main goal of this Coastal RSM Plan is to formulate and provide consensus-driven regional sediment management guidance and policy under the direction of SANDAG and in coordination with the CSMW to:

- Restore and maintain coastal beaches and other critical areas for human recreation and protection of coastal infrastructure, (Highway 101, utilities, etc);
- Reduce the need for, number of and/or proliferation of "hard" protective structures (e.g., seawalls and revetments) along the toes of coastal bluffs or fronting shoreline developments;
- Sustain economics, recreation, and tourism generated by beaches;
- Enhance public safety and access; and
- Restore coastal sandy habitat areas throughout the region for invertebrates, shorebirds, and other species that use beaches.

As such, development of this Coastal RSM Plan includes assessment of existing sediment management practices, review of existing policies, conducting consensus-building stakeholder meetings, and formulation of proposed plans. The purpose of the Plan is to provide coordinated guidance and policy to manage coastal sand within the region.

1.2.2
Adoption of the Plan

The intent of preparing this Coastal RSM Plan is ultimately for adoption by SANDAG and is envisioned to guide all future actions related to projects in the coastal zone. Adoption of this Coastal RSM Plan by SANDAG is the first step towards ensuring that the Plan is consulted during sediment management activities throughout the San Diego region. SANDAG is best positioned to maintain the regional perspective needed to coordinate the various activities identified in this section and ensure that the Plan's goals and objectives are met. This Coastal RSM Plan may serve as the basis for developing specific future regional and local programs and ordinances to enact its recommendations. Having an adopted Coastal RSM Plan should also assist in obtaining state and federal funds to implement projects, as the major funding agencies are committed to regional sediment management.

1.2.3
Meet SANDAG's Future "Quality of Life"

There are many critical infrastructure needs facing the San Diego region, with limited resources available to meet them. The RCP, adopted by the SANDAG Board of Directors in July 2004, was intended to take a comprehensive view of the region to strategically link land use, transportation, and other infrastructure needs. Development of the RCP involved collaboration with stakeholders, the public, and policymakers, to establish a long-term planning framework for the San Diego region. Since the RCP was adopted, SANDAG has worked to implement components of the RCP, including the development of the Smart Growth Concept Map and a Pilot Smart Growth Incentive Program, the Regional Transportation Plan (RTP), and the Regional Economic Prosperity Strategy (REPS). In 2007, SANDAG began to consider other infrastructure needs in the region and the best way to achieve the vision outlined in the RCP.

The RCP sets forth a vision for the region in the year 2030 and lays out a policy framework to achieve that vision based on three principles:

1. Improving connections between land use and transportation plans using smart growth principles;

2. Using land use and transportation plans to guide decisions regarding public facility and environmental investments; and

3. Focusing on collaboration and incentives to achieve regional goals and objectives.

As the San Diego region continues to change, SANDAG must regularly assess the ability of infrastructure to handle that change and to maintain the quality of life at acceptable levels. To adequately prepare for this change, steps need to be taken to help ensure that infrastructure is in place prior to or concurrent with land use decisions that help implement the urban form and design goals identified in the RCP.

Because of the lack of available resources at the national and state level to help finance transportation as well as other regional and local infrastructure needs, regions are increasingly being asked to leverage or match state and federal funds with local money or programs that help fill the infrastructure gaps.

The Integrated Regional Infrastructure Strategy (IRIS), a key element of the RCP, was produced to identify ways of addressing this trend of greater regional responsibility for providing and funding its infrastructure needs. The IRIS outlines a strategy for working with regional infrastructure providers to develop a forward-looking planning, investment and financing strategy that will help the San Diego region meet its collective regional infrastructure needs.

Most of the region's infrastructure providers have a system in place to address their needs and prioritize their expenditures. However, IRIS identified three regional infrastructure areas that are significantly underfunded: 1) habitat preservation, 2) beach sand replenishment, and 3) storm water management. Generally speaking, these three infrastructure areas do not have a system in

place to address their funding needs and prioritize their expenditures. For this reason, the IRIS and RCP recommended that SANDAG take a role in initiating a process to develop a system that addresses each of their infrastructure needs, including a process to prioritize expenditures.

When voters approved the extension of the *TransNet* one-half cent sales tax in November 2004, the expenditure plan included a specific funding allocation of $850 million for "environmental mitigation:" $650 million for direct mitigation of transportation projects identified in MOBILITY 2030 and up to $200 million for habitat monitoring, management, and acquisition not associated with specific project mitigation. The $200 million is available based on the economic benefits of purchasing land in advance of need in larger blocks at a lower cost. It was recognized at that time that this funding would not be adequate to accommodate the entire regional need for habitat preservation identified in the adopted Multiple Species Conservation Plan (MSCP) and Multiple Habitat Conservation Plan (MHCP).

Therefore, the *TransNet* Extension measure stated that SANDAG "…will act on additional regional funding measures (a ballot measure or other secure funding commitments) to meet long-term requirements for implementing habitat conservation plans in the San Diego region, within the timeframe necessary to allow a ballot measure to be considered by the voters no later than four years after passage of the *TransNet* Extension." To meet this commitment, the SANDAG Board of Directors should begin to discuss various funding alternatives that are reasonable to fulfill this obligation.

In January 2007, the Board began discussing strategies to meet this obligation. The Board directed its staff to schedule Board policy meetings to allow a thorough discussion of issues related to the need for additional regional funding for habitat conservation as addressed in the EMP principles. The Board also wanted to consider shoreline management, water quality, and transit operations as important regional "quality of life" components identified in the Regional Comprehensive Plan as they do not have a dedicated, long-term funding source. The Board discussed the difficulty identifying a funding strategy that would only address habitat preservation and not other regional needs, which is how the "Quality of Life funding" concept was initiated. Since that time, this process has evolved to include public transit funding in any Quality of Life funding strategy developed.

Sand replenishment at the region's beaches is needed to counter the effects of erosion, which has resulted in part from upland and upcoast development. The SANDAG Board has recognized the importance of developing a long-term funding program for beach sand replenishment with the adoption of the SPS in 1993 and the completion of RBSP I in 2001. Ongoing and future efforts are focused on placing sand at regional beaches. However, currently there are no regional revenue sources that exist to implement the beach sand-replenishment program.

There have been efforts undertaken by local jurisdictions, such as the City of Encinitas and most recently the City of Solana Beach, to dedicate funding for beach nourishment. However, without a regional funding source to support large-scale replenishment, these funds are best used for a jurisdiction's small-scale replenishment projects and infrastructure improvements. Therefore, the Quality of Life funding strategy considers beach nourishment both with and without sediment retention over the next 40 years.

1.2.4
Sea Level Rise

Another important consideration is whether the actions of coastal sediment management will be effective in the face of global sea level rise. Sea level rise is presently occurring roughly at a rate of 3 feet per century (with broad ranges depending on the source considered), or 0.36 inches per year (IPCC 2007). Possible rates vary between regions, and estimates also vary between agencies. A recent study issued by the Pacific Institute (2009) offers a rate of up to 55 inches over 100 years. The effect of sea level rise will cause further narrowing of beaches as water levels rise relative to land elevations. This Plan offers a vision for the 50-year future. Sea level rise over that 50-year timeframe will be less than that predicted over the next 100-years, yet it is an important factor that needs to be considered for project designs.

Coastal sediments are basically sequestered offshore as ocean water levels rise relative to land. Therefore, coastal sand losses and narrowing of beaches will accelerate into the future if no action is taken. Regional sediment management is one mechanism to counter the effects of sea level rise and maintain functional sandy beach areas. Restoring beaches (with sediment management devices) is the most effective method of protecting against the detrimental effects of sea level rise. SANDAG is committed to maintaining beaches as an approach to counter sea level rise. A Coastal RSM Plan is therefore needed to address associated effects of maintaining the region's beaches, thereby addressing impacts associated with sea level rise. The effects of sea level rise on this Plan may be that the quantities of sediment anticipated to be necessary to restore the region may have to increase over time, with more gradual increases over 50 years, and greater increases beyond that timeframe.

Detailed designs of individual projects as they come on-line should be done in the future in consideration of sea level rise. This is a planning document rather than an engineering design document so detailed analyses of effects of sea level rise are not presented. However, as the Plan moves forward and projects are proposed, then detailed analyses of sea level rise and project designs must occur for environmental review, permitting, and engineering for construction. This Plan is intended to be adapted and updated over time using results of monitoring. Monitoring results will include effects of sea level rise. For the Plan to be effective, future iterations and designs must include any modifications to address effects of sea level rise on specific project actions.

1.3 Report Organization

This Coastal RSM Plan is organized into sections presenting various aspects of the project including:

- Coastal processes;
- Potential receiver sites;
- Sediment sources;
- Approaches for regional sediment management for various sources;
- Solutions to the coastal erosion problem;
- Additional considerations of alternatives such as economics, funding, and permitting;

- Governance for implementation;
- Monitoring;
- Data gaps and next steps; and
- Conclusions.

References and appendices are provided at the end of the document.

1.4 Definitions

- Backshore: The upper part of the active beach above the normal tidal reach and wave run-up (high water), but episodically affected by high waves occurring during a spring high tide.
- Beach: That portion of land and seabed above Mean Lower Low Water (MLLW). Includes the foreshore and backshore areas.
- Beach Profile: A cross-section through the beach perpendicular to the beach slope; it may include a dune face or sea wall, extends across the beach into the nearshore zone to the closure depth.
- Closure Depth: The maximum depth of average seasonal cross-shore sand movement. This depth represents the seaward end of the beach profile, and essentially remains unchanged on average over the long term. Sand that moves beyond the depth of closure in a seaward direction is typically lost to the littoral cell and not available for natural seasonal beach recovery. The actual closure depth is typically approximately -30 feet Mean Lower Low Water (MLLW) in Southern California and -40 feet MLLW or deeper in Northern California.
- Compatibility: When the range of grain sizes of a potential sand material source lies within the range (envelope) of natural grain sizes existing at the receiver site, with certain allowances for exceedances of cobbles and fine-grained sediments.
- Fine-grained Materials (or Fines): Clays and silts, passing the #200 soil grain size sieve, or less than 0.074 millimeters in diameter.
- Foreshore: In general terms, the beach between approximately Mean Higher High Water and Mean Lower Low Water.
- Less-than-Optimum Beach Fill Material: Material that is not compatible in grain size with sand at the dry beach, but is compatible with material within the nearshore portion (between MLLW and the closure depth) of the receiver site. The fines fraction should be within 10% of that contained within existing nearshore sediments that exist along a profile. Typically, the percent fines of the nearshore portion of a beach profile in California can range from 5% to 35% fines. Therefore, less-than-optimum beach fill material may contain between 15% and 45% fines.
- Littoral Cell: A reach, or compartment, of the shoreline in which sediment transport is bounded. In theory, it has zero longshore sediment transport beyond its updrift and downdrift boundaries. It contains sediment sources (e.g., rivers, coastal bluffs), storage areas (beaches), and sinks (submarine canyons).

- Nearshore: The seafloor along a coast between the closure depth (typically near -30 feet MLLW.
- Offshore: That part of the seabed below the depth of closure.
- Opportunistic Sand: Surplus sand from various source materials, including upland construction, development projects, and flood control (e.g., dams, channels, and debris basins).
- Optimum Beach Fill Material: Material compatible with the dry beach portion of the beach profile. The fines fraction of the grain size of this material can be within 10% of that of the existing dry beach sediments, which typically range from 0% to 5% fines. Therefore, optimum beach fill material may contain up to 15% fines.
- Receiver Site: The entire related system of coastal environments that would receive opportunistic materials, including the beach, nearshore and offshore regions.
- Sediment: Loose, sandy geologic material that is suitable for placement at the coast to nourish the littoral zone. This material is assumed to possess a significant fraction of sand, upwards of 75%. However, in some instances sediment with a sand fraction from 51% to 75% may also be suitable for beneficial reuse at the coast, depending on location.
- Upland Sediment: Surplus sandy material available for beach fill from sources located inland from the mean high tide line. They can constitute dry sources at away from rivers and lakes, or wet sources at rivers and lakes.

Acronyms and initialisms used in this Coastal RSM Plan include:

- CCC - California Coastal Commission;
- CDFG - California Department of Fish and Game;
- CEQA - California Environmental Quality Act;
- CSLC - California State Lands Commission;
- CSP - California State Parks;
- CSMW - Coastal Sediment Management Workgroup;
- DBW - Department of Boating & Waterways;
- NOAA - National Ocean and Atmosphere Administration;
- NEPA - National Environmental Policy Act;
- NMFS - NOAA National Marine Fisheries Service;
- RWQCB - Regional Water Quality Control Board;
- SANDAG - San Diego Association of Governments;
- SCOUP - Sand Compatibility and Opportunistic Use Program;
- SIO - Scripps Institution of Oceanography;
- USACE - U.S. Army Corps of Engineers;

- USEPA - U.S. Environmental Protection Agency;
- USFWS - U.S. Fish and Wildlife Service, and
- USGS - United States Geological Survey.

2.0

SCOPE OF WORK

2.1 Develop the Coastal RSM Plan and RSM Tools

Coastal RSM Plan development consists of 12 subtasks that inventory all pertinent existing conditions of sand source and receiving beach areas and determine appropriate sand management approaches. The subtasks in the contracted scope of work include:

1. Compile Relevant Coastal References and Sediment Information (see Appendix A);
2. Locate Beach Erosion Concern Areas (BECAs) within the Region;
3. Identify Potential Sand Sources Including Harbors, Wetlands, Flood Control Sites, Offshore Areas, and Construction and Highway Projects; and Other Inland Sites Such as Dams and Sediment Detention Basins;
4. Compile Available and Appropriate Sediment Quality Data for Beaches and Sources;
5. Identify Innovative Technologies;
6. Determine the Economic Feasibility of Removal, Transport, and Placement of Potential Source Materials;
7. Collate Available Data of Physical and Chemical Sediment Compatibility;
8. Assess and Georeference Locations of Critical Species and Habitats;
9. Identify Data Gaps;
10. Assess the Viability of Nearshore Receiver Sites;
11. Identify Permitting Requirements; and
12. Identify Potential Sources of Local and Regional Funding Streams for Incremental Costs Associated with Beneficial Use of Sediment Across the Region.

2.2 Perform Public Outreach

Public outreach was performed at four public workshops held throughout the region, and by assisting SANDAG with expanding the existing list of stakeholders, contributing to existing websites of SANDAG and the CSMW, and generating technical information that SANDAG can use to prepare brochures. The draft Plan was made available for public review through SANDAG and CSMWs website, and comments solicited. See Appendix B for contact information from public workshops.

2.3 Recommend a Governance Structure that will Effectively Support Implementation of the Plan

The consultant is to assist SANDAG in generating practical and feasible ideas for recommending a governance structure. Assisting with governance involved the following subtasks:

1. Identify additional stakeholders not presently involved in the SPWG meetings;
2. Determine coordination and cooperative agreements (assuming SANDAG enacts them) to implement the Coastal RSM Plan;
3. Identify jurisdictional agencies, boundaries, and regulatory impediments within the region;
4. Assess any unique additional local issues that could affect the Coastal RSM Plan; and
5. Adoption of the Coastal RSM Plan by SANDAG, representing their commitment to utilize and/or reference the Plan whenever appropriate.

2.4 Prepare the Draft and Final Plan

This task involves preparing the actual Coastal RSM Plan document. The Coastal RSM Plan includes information listed below:

1. A list of references of coastal resources and sand information to be used during performance of this work scope;
2. A GIS layer and map product of BECAs to be used during performance of this work scope – these products were provided separately to the CSMW for incorporation into their statewide "California Beach Restoration Study" (CBRES, which may be renamed later as a final version);
3. Matrices and maps of sand sources;
4. Matrices of available sediment quality information of sources and receiver sites, with georeferenced information for the CSMW database;
5. Concepts for innovative nourishment technologies;
6. Quantified economic feasibility of sand management options;
7. Matrices and maps of physical and chemical sediment compatibility of source and receiver sites, stockpiles, transport routes, and placement options;
8. Tables or figures of sensitive habitats and species in the vicinity of coastal sand sources and receiver sites based on existing information from available information sources, geo-referenced data on western snowy plover critical habitat in San Diego County based on information in the Federal Register listing of critical habitat for the species, and geo-referenced data on sensitive bird species available based on coordination with the USFWS and U.S. Navy;
9. Check-list table of available information and data gaps for material characteristics, sources, sensitive species and sensitive habitat types, organized by coastal sand source and receiver sites, and programmatic recommendations for filling critical biological and sand resource information gaps according to the type of data gap;
10. Recommendations on nearshore receiver sites and possible conceptual placement areas and technologies;
11. A matrix of permitting requirements as taken from previous related work;
12. A matrix of funding opportunities;

13. Website information;
14. Identification of possible cooperative agreements needed within the region for the Plan and impediments to Plan implementation;
15. Possible scenarios/concepts of sand management and re-use to maximize effects and minimize costs and environmental and social impacts;
16. Recommendations on governance structure; and
17. Steps needed to implement the Coastal RSM Plan.

3.0

COASTAL PROCESSES

A brief description of the region's coastal processes is provided for context in considering the Coastal RSM Plan. Coastal processes determine the existing patterns of sediment transport, erosion, and deposition along the coast. As such, they are important to understand in formulating the Plan. Coastal processes addressed herein include sediment budgets, longshore sediment transport rates, and wave climate. The *Coast of California Storm and Tidal Waves Study, San Diego Region* is a major source of sediment budget and longshore sediment transport data for the three littoral cells within the project area (USACE 1990 and 1991). This study was the most comprehensive work done for this region to date. Although somewhat dated, it still provides more accurate region-specific information than any other source. Information from this section was also taken from the Shoreline Morphology Study for RBSP I (Moffatt & Nichol 2000b), Shoreline Erosion Assessment and Atlas of the San Diego Region (DBW/SANDAG 1994), and the more recent study on Regional Sediment Budgets for California's Major Littoral Cells by Patsch and Griggs (2006).

3.1 Sediment Budgets and Longshore Sediment Transport Rates

The sediment budget approach was developed to understand the impact of coastal processes on shoreline change. The sediment budget conceptually accounts for inflows (sources), outflows (sinks), and storage of sediment within a defined geographic unit referred to as a littoral cell. The littoral cell is a segment of coastline that does not significantly transport or receive littoral sediment to or from another cell in either the "upcoast" or "downcoast" direction (USACE 1990 and 1991), although some evidence indicates sand can occasionally bypass submarine canyons and enter adjacent cells. However, within the cell a complete cycle of sedimentation exists that can include erosion of upland terrain, fluvial transport to the shoreline, and littoral transport along the shoreline with temporary storage at beaches.

Once sediment is entrained in the littoral transport system it can be lost to that system through aeolian losses to dunes, cross-shore transport offshore, or by channeling of the sediment onto the continental shelf via a submarine canyon. Sediment sources to a cell include rivers, bluffs, dunes, and artificial nourishment. Sediment sinks include submarine canyons, cross-shore losses to the offshore during storms or from deflection by structures, and inland losses via wind transport. Sand moves through a littoral cell along the beach and/or nearshore zone from source to sink, and is temporarily stored at beaches within the cell. The sediment budget is either in balance with stable beaches, in a surplus with accreting beaches, or in a deficit with eroding beaches.

Sediment budget information clarifies whether beaches in the littoral cell are eroding, accreting, or stable. Longshore sediment transport reflects the volume and rate of sand moving through a coastal reach over time. Both aspects of coastal processes are summarized below. Sediment

budget data are quantified in USACE (1990 and 1991) and Patsch and Griggs (2006), while longshore sediment transport data are taken from the USACE work.

Longshore sediment transport (aka "littoral drift") occurs in both upcoast (north) and downcoast (south) directions. The direction changes seasonally and depends on wave conditions. The total amount of sediment movement over a year is referred to as the gross transport rate. The difference between the upcoast and downcoast sediment transport rates is referred to as the net transport rate. The volume and direction of net sediment transport represents the effective or predominant littoral drift used in sediment budget calculations.

3.1.1
Oceanside Littoral Cell

Sediment Budget

The Oceanside Littoral Cell extends from Dana Point to Point La Jolla (Figure 4). The Oceanside Harbor North Jetty represents an effective, artificial barrier to sediment transport from the northern to southern portion of the littoral cell, and the Marine Base Camp Pendleton occupies much of the coastline north of Oceanside. For these reasons, the San Diego Region Coastal RSM Plan project area incorporates the southern Oceanside subcell from approximately Oceanside Harbor to La Jolla, as the southern portion of this cell constitutes practical sand placement areas. Several potential sediment sources have been identified within and offshore of Camp Pendleton, but the possibility of utilizing materials from the military base is complex and will require coordination and cooperation between SANDAG and Camp Pendleton, a process which has begun. The reach from Oceanside Harbor to Scripps Submarine Canyon was in a deficit of nearly 55,000 cubic yards per year (Patsch and Griggs 2006), as evidenced by widespread beach retreat since the early 1980s (DBW/SANDAG 1994).

Longshore Sediment Transport Rates

Several previous estimates exist for longshore sediment transport in the Oceanside Littoral Cell (USACE 1990 and 1991). The estimates range widely depending on the method used for calculation, but generally the maximum estimate of gross transport is 1,400,000 cubic yards per year and the minimum estimate is 400,000 cubic yards per year, with an average near 1,000,000 cubic yards per year. Net sediment transport ranges from 100,000 to 250,000 cubic yards per year to the south (USACE 1991).

Minor reversals in the dominant sediment transport direction occur seasonally, and sometimes extend over longer periods of years. Summer and fall seasons are typically dominated by southern hemisphere swells that generate currents and sediment transport to the north. The southern hemisphere swell component can dominate over certain years (e.g., El Niño years) causing net sediment transport to be to the north rather than to the south. Winter and spring seasons are typically dominated by northern hemisphere swells that generate currents and sediment transport to the south. This winter/spring condition is typified by higher energy waves than summer/fall conditions and so it tends to be the dominant process over the long-term. Therefore, the long-term net sediment transport direction is considered by most researchers to be to the south (USACE 1991).

3.1.2
Mission Bay Littoral Cell

Sediment Budget

This cell extends from Point La Jolla to Point Loma (Figure 4). The subcells of the cell relevant to this study include Mission Beach (north of the Mission Bay entrance channel) and Ocean Beach (south of the Mission Bay entrance channel). According to the USACE (1990 and 1991), the Mission Beach subcell is in a deficit of 10,000 cubic yards per year, and the Ocean Beach subcell is in a deficit of 7,000 cubic yards per year. The deficit for the entire Mission Bay littoral cell was estimated at 40,000 cubic yards per year by Patch and Griggs (2006).

Longshore Sediment Transport Rates

The average gross sediment transport along Mission Beach and Ocean Beach is 200,000 cubic yards per year and net longshore sediment transport is between 20,000 and 90,000 cubic yards per year to the south (USACE 1991).

3.1.3
Silver Strand Littoral Cell

Sediment Budget

This littoral cell extends from Point Loma to the Coronado Canyon in Mexico (Figure 4). Subcells in this cell relevant to this Coastal RSM Plan extend from Coronado Canyon to the Tijuana River delta (Tijuana River Delta subcell), and from the Tijuana River delta to the San Diego Bay entrance channel (the Strand subcell). The Silver Strand Littoral Cell is either in a sediment deficit according to the USACE (1991) or a sand surplus according to Patsch and Griggs (2006).

According to the USACE, the deficits range from 65,000 cubic yards per year in the Tijuana River Delta subcell to 40,000 cubic yards per year in the Strand subcell (USACE 1990 and 1991). At the Tijuana River Delta subcell, average yearly sediment inflows include 65,000 cubic yards from the Tijuana River. Outflows include 65,000 cubic yards per year southward into Mexico and 65,000 cubic yards per year northward toward Imperial Beach (USACE 1990 and 1991). For the Strand subcell, average yearly sediment inflows include 25,000 cubic yards per year from artificial nourishment, 65,000 cubic yards per year alongshore from the Tijuana River Delta subcell, and 65,000 cubic yards per year from offshore sources (the Tijuana River Delta). Sediment outflows include 25,000 cubic yards per year by wind to dunes and 170,000 cubic yards per year alongshore northward along the Silver Strand to Zuniga Shoal and San Diego Bay at the north end of the subcell (USACE 1990 and 1991).

Patsch and Griggs (2006) indicate that presently a surplus exists in this cell due to beneficial effects of beach nourishment. Without nourishment, this subcell would be in a deficit of approximately 41,000 cubic yards per year. As nourishment in this subcell has occurred sporadically and in relatively small amounts, this subcell may be in a deficit condition at this time.

Longshore Sediment Transport Rates

Gross sediment transport is 740,000 cubic yards per year throughout the littoral cell, and net longshore sediment transport is to the north from between 120,000 and 200,000 cubic yards per year. Patsch and Griggs (2006) indicate a split in transport direction may occur at the vicinity of the Tijuana River delta.

3.2 Wave Climate

Waves are the driving force in generating longshore currents, sediment transport, and shoreline changes. The wave climate within the project area is described below.

3.2.1 Wave Sources

Four main categories of ocean waves occur off the coast of Southern California: 1) northern hemisphere swell, 2) tropical swell, 3) southern hemisphere swell, and 4) seas generated by local winds. Each wave type is described below.

- Northern hemisphere swell includes the most severe waves reaching the San Diego County coast. Deepwater significant wave heights rarely exceed 10 feet, with wave periods ranging from 12 to 18 seconds. However, during extreme northern hemisphere storms, wave heights may exceed 20 feet with periods ranging from 18 to 22 seconds.

- Tropical storms develop off the west coast of Mexico during the summer and early fall. The resulting swell rarely exceeds 6 feet, but a strong hurricane in September 1939 passed directly over the Southern California area and generated waves recorded at 26.9 feet.

- Southern hemisphere swell is generated by winds associated with winter storms in the South Pacific. Typical southern hemisphere swell rarely exceeds 4 feet in height in deep water, but with periods ranging up to 18 to 21 seconds, they can break at over twice that height.

- Sea is the term applied to steep, short-period waves which are generated either from local storms, strong pressure gradients over the area of the Eastern Pacific Ocean (Pacific High), or from the diurnal sea breezes. Wave heights are usually between 2 and 5 feet with an average period of 7 to 9 seconds.

A wave exposure diagram is shown in Figure 5. The San Diego region is directly exposed to ocean swell entering from three main windows (California Data Information Program or CDIP 2008; Moffatt & Nichol Engineers 1988 and 2000b). The northernmost window extends from approximately 310 to 280 degrees (relative to true North) where wind waves cause local seas in the Santa Barbara Channel that can travel to San Diego County. The northwest window, where severe northern hemisphere storms enter, extends from 290 to 250 degrees. The Channel Islands (San Miguel, Santa Rosa, Santa Cruz and Anacapa) and Santa Catalina Island provide some

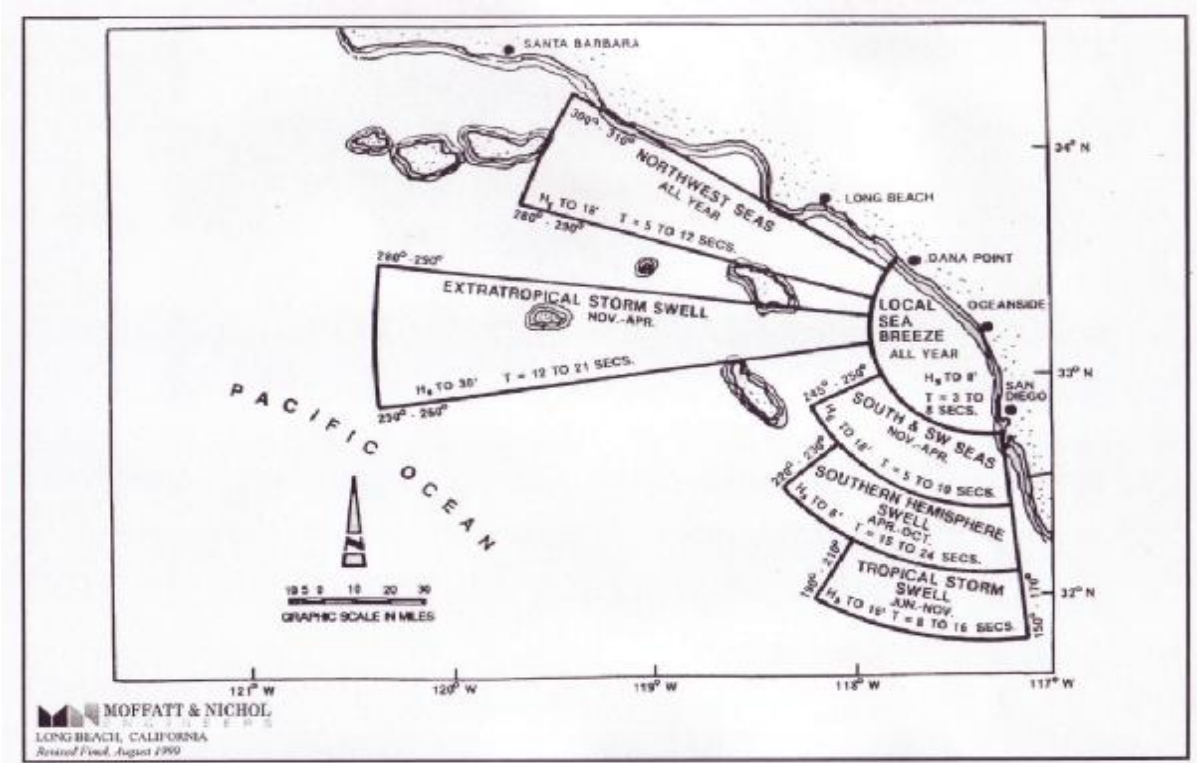


Figure 5 – Wave Exposure Diagram

sheltering from the higher waves associated with these two windows, depending on the approach direction. The other major exposure window opens to the south from 250 to 150 degrees, allowing swell from southern hemisphere storms, tropical storms (hurricanes), and pre-frontal seas.

With the predominance of wave energy reaching this coastline from the northern hemisphere, wave-driven currents typically run from north to south throughout winter and spring and cause the majority of longshore sediment transport. As this coast is also significantly exposed to southern swell (from both the southern and northern hemispheres), seasonal reversals in littoral drift and longshore sediment transport occur. Variable climatic cycles result in a range of conditions from dominant southward sediment transport over certain periods, followed by periods of more balanced sediment transport directions. The shoreline morphology adjusts to predominant conditions and over the long-term is oriented to southward sediment transport, with sediment inputs to the littoral cell typically from the north and outputs from the littoral cell typically to the south.

3.3 Theoretical Subcells Within the San Diego North County Region

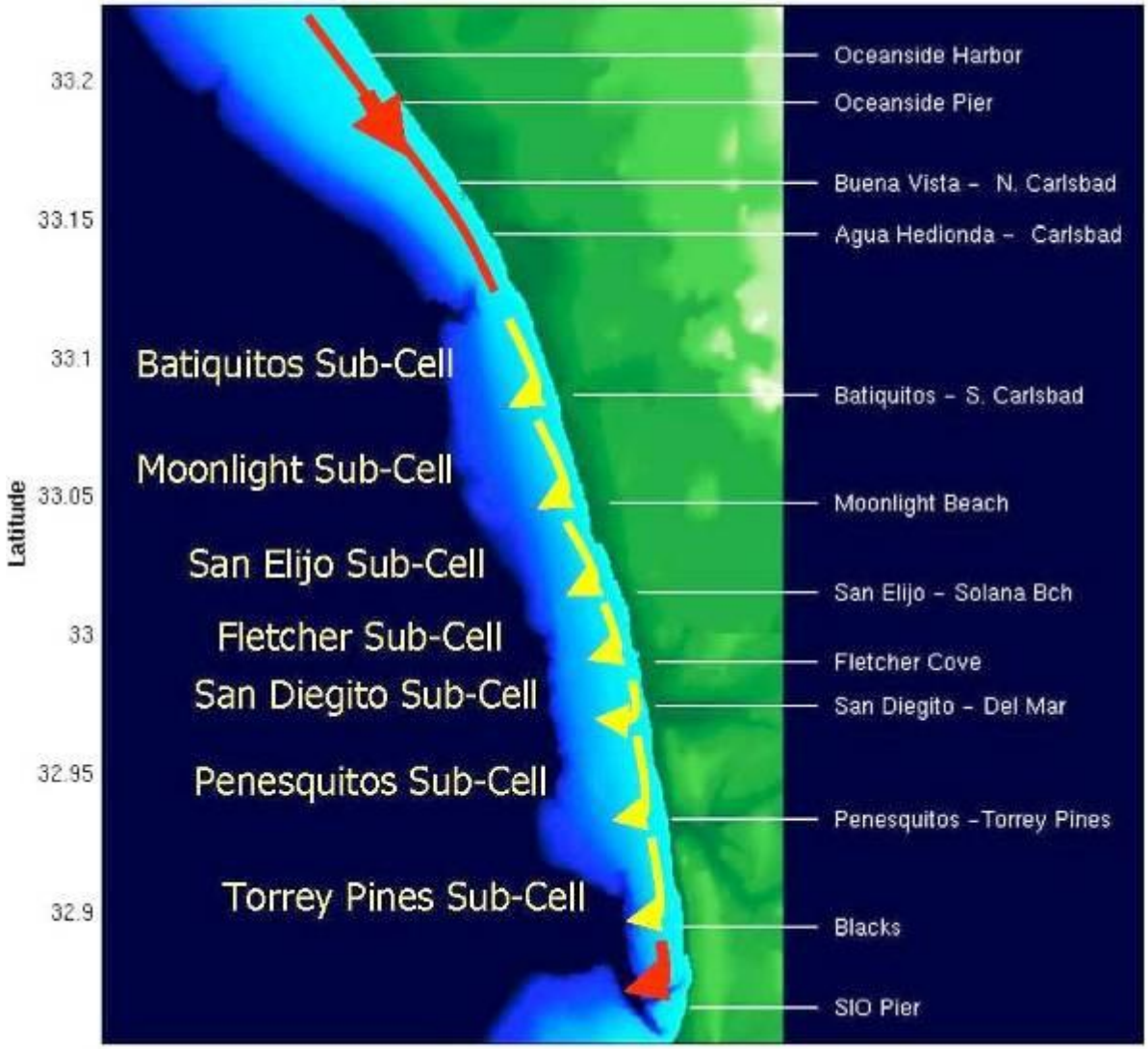
CDIP at SIO has used an extensive network of directional wave buoys to reconstruct a detailed 5-year nearshore wave climate for the mainland coast of California from San Diego to Point Conception. The resulting cumulative annual statistics of potential alongshore and cross-shore transport rates suggest that numerous wave-driven coastal lagoon littoral subcells exist within the larger submarine canyon-bounded Oceanside Littoral Cell system.

The shelf bathymetry is hypothesized to create these littoral subcells, where transport patterns vary from predominantly cross-shore to alongshore. Relic sediment fans in ~20 meter water depths offshore of lagoons and creeks act as refraction lenses which amplify wave energy creating potential erosion hotspots resulting in areas of strong net offshore transport. Adjacent to and downcoast of these areas of energetic waves, are sections of coastline where the net annual cumulative alongshore transport rate is near zero. These adjacent pairs of strong net offshore transport and weak net alongshore transport creates wave-driven sinks. Alongshore net transport is largest between lagoons and decreases near lagoon entrances (O'Reilly, Personal Communication 2008, and O'Reilly 2008).

The existence of wave-driven coastal lagoon littoral subcells and the dynamics of sediment transport within these subcells have significant implications for regional sediment management. Ongoing research efforts at CDIP are focused on corroborating the existence of littoral subcells by monitoring nearshore waves and sand elevations in San Diego County through its recently implemented MOnitoring and Prediction (MOP) System (http://cdip.ucsd.edu).

The wave-driven littoral subcell theory suggests that longshore sediment transport will be highest between lagoon locations and inshore of historic kelp beds, such as at Tamarack, South Carlsbad State Beach, Leucadia, North Cardiff Beach State Beach, South Del Mar, and South Torrey Pines State Beach. Sediment placed at these areas should remain relatively close to shore and move downcoast to the south over time. In contrast, offshore transport of sediment is highest immediately off or just downcoast of lagoon locations causing beach erosion hot spots. Examples of these sites are North Carlsbad State Beach, Terramar Point, Batiquitos Beach, Moonlight Beach, South Cardiff State Beach, Fletcher Cove, north Del Mar, and North Torrey Pines State Beach. Sediment placed near these sites may move primarily offshore and be lost to the system, rather than moving alongshore. An example of this condition is shown in Figure 6.

This work is still ongoing and will be published in the near future. It bears on the recommended placement sites for sediment, and for potential offshore sediment sources as well. This Coastal RSM Plan presents various proposed sediment placement sites throughout the region, including some that may be affected by this offshore sediment transport condition hypothesized by SIO. The RSM receiver sites presented in this Plan are initial proposals that can be modified over time (adaptive management) while the SIO theory is formalized and monitoring occurs to provide more information.



Source: SIO, William O'Reilly 2008

Figure 6 – Wave-Driven Lagoon Sub-Cells

4.0

POTENTIAL COASTAL RECEIVER AREAS

The San Diego shoreline, including the beaches, bluffs, bays, and estuaries, is a significant environmental and recreational resource. It is an integral component of the area's ecosystem and is interconnected with the nearshore ocean environment, coastal lagoons, wetland habitats, and upstream watersheds. The beaches are also a valuable economic resource and key part of the region's positive image and overall quality of life.

The shoreline consists primarily of narrow beaches backed by steep sea cliffs. In present times, the coastline is erosional except for localized and short-lived accretion due to historic nourishment activities. The beaches and cliffs have been eroding for thousands of years caused by ocean waves and rising sea levels which continue to aggravate this erosion. Episodic and site-specific coastal retreat, such as bluff collapse, is inevitable, although some coastal areas have remained stable for many years.

In recent times, this erosion has been accelerated by urban development. The natural supply of sand to the region's beaches has been significantly diminished by flood control structures, dams, siltation basins, removal of sand and gravel through mining operations, harbor construction, increased wave energy since the late 1970s, and the creation of impervious surfaces associated with urbanization and development. With more development, the region's beaches will continue to lose more sand and suffer increased erosion, thereby reducing, and possibly eliminating their physical, resource and economic benefits.

The *State of the Coast Report, San Diego Region* (USACE 1991) evaluated the natural and man-made coastal processes within the region. This document stated that during the next 50 years, the San Diego region "…is on a collision course. With sandy beaches backed by sea cliffs, beach erosion and failure of the sea cliffs must be anticipated. Extensive damage and loss of property will occur. While the amount of erosion is dependent upon sea level change, as well as the wave climate, particularly severe storm events," the report concludes that "all the beaches of the San Diego region are threatened with erosion." According to the USACE, "…the apparent stability of the beaches is belied by rigorous examination of the historical beach profiles and summation of previous beach nourishment. Without the earlier massive input of beach fill, the shoreline of the San Diego Region would exhibit nearly continuous erosion from Oceanside Harbor to the international border. New sources of beach-quality sand need to be readied for beach nourishment following severe storm events and for long-term protection from rising sea level."

4.1 Beach Erosion Sites

Beach erosion is continually documented by the federal, state, regional, and local governments. The CSMW focuses on addressing statewide sediment management and has systematically inventoried BECAs throughout coastal California, including those of local concern in selected

areas of the coast. SANDAG is assessing BECAs within the San Diego Coastal RSM Plan region, and inventories of coastal erosion areas are provided in the pages to follow.

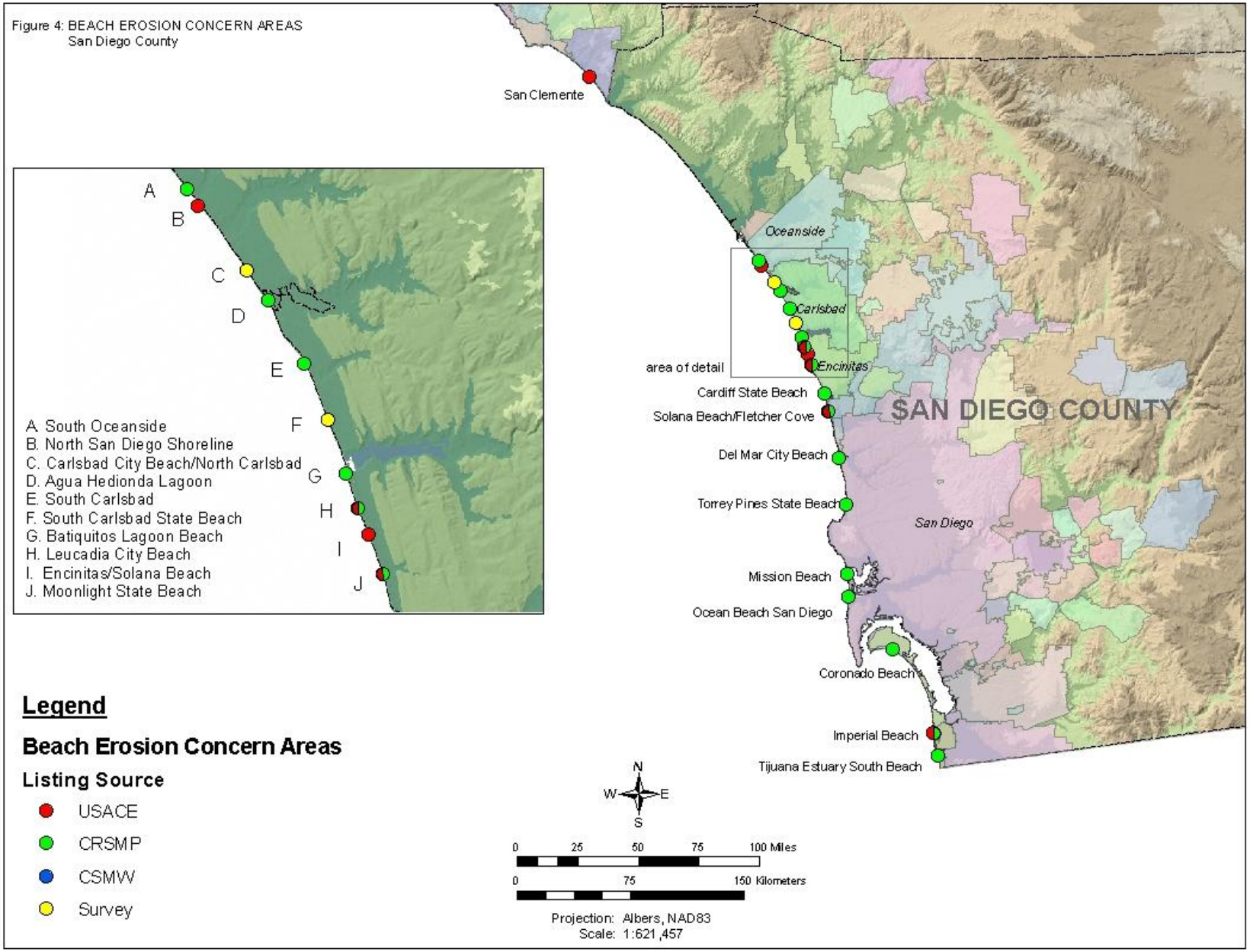
4.1.1
State Beach Erosion Concern Areas

The draft California Beach Restoration Survey (2008) presents information about BECAs, including those in the San Diego region provided to CSMW by SANDAG and USACE (Figure 7). These sites have been identified through various data sources including: local surveys done by Cities or SANDAG as part of monitoring programs, extensive analyses by the USACE (1990 and 1991), analyses performed by DBW/SANDAG (1994), a survey conducted by DBW in 2000, and locations currently being investigated for federal interest by the USACE. Recent evaluation of erosion areas was performed by SANDAG and the CSMW as part of the SCOUP (Moffatt & Nichol 2006). The SCOUP program evaluated potential erosion areas and recommended sand placement sites for opportunistic sand. The sites identified by the various efforts listed above are listed in Table 2, and comprise the recommended initial BECAs for this Coastal RSM Plan.

Table 2 – Beach Erosion Concern Areas Compiled by the CSMW

Reach of Coast	Source of Designation
North County San Diego/South Oceanside	Survey; USACE; CRSMP
North Carlsbad State Beach	CRSMP
Agua Hedionda/Encinas	CRSMP
South Carlsbad State Beach/Encinas Creek	Survey; CRSMP
Batiquitos Beaches (in Carlsbad and Encinitas)	CRSMP
Encinitas/Leucadia Beach	USACE; CRSMP
Encinitas/Moonlight Beach	USACE; CRSMP
Cardiff State Beach/San Elijo Lagoon Beach	CRSMP
Solana Beach/Fletcher Cove	USACE; CRSMP
Del Mar City Beach/San Dieguito Lagoon Beach	CRSMP
Torrey Pines State Beach	CRSMP
Mission Beach	CRSMP
Ocean Beach (San Diego)	CRSMP
Coronado	CRSMP
Imperial Beach	USACE; CRSMP
Border Field State Park Beach	CRSMP

Sources:
Survey - Location identified in DBWs initial survey of erosion sites
USACE - Location under assessment for federal interest
CRSMP - Location identified within this Coastal RSM Plan



Source: CSMW 2008

Figure 7 – State of California Beach Erosion Concern Areas

The Mission Beach, Ocean Beach, and Coronado BECAs are less erosive then the others, but they do experience periodic problems during severe winter storm waves.

4.1.2
SANDAG Shoreline Erosion Problem Areas

SANDAG has identified "problem" coastal erosion areas in the SPS (1993) (Figure 8). The problem areas were identified based on existing beach profile surveys by the USACE and observations made by SANDAG member agencies. DBW/SANDAG (1994) inventoried the region and categorized each beach according to its erosional condition. The analysis by SANDAG and DBW was consistent with the SPS.

In North County, the entire reach of coast from Oceanside to La Jolla Shores is considered an erosion problem area. There is a lengthy reach of erosion throughout North County and it requires some sort of remediation in the opinion of SANDAG and its members. The condition of eroding coastal bluffs from La Jolla through Oceanside, with intermittent narrow beaches along low-lying backshore areas near lagoons, supports this conclusion. Another extensive problem area exists throughout Imperial Beach to south of the Mexican Border in South County. USACE research (1990 and 1991) shows a high erosion rate along this reach of coast, and observations by DBW/SANDAG (1994) shows evidence of this erosion. Erosion is documented and observed to the present by monitors and locals.

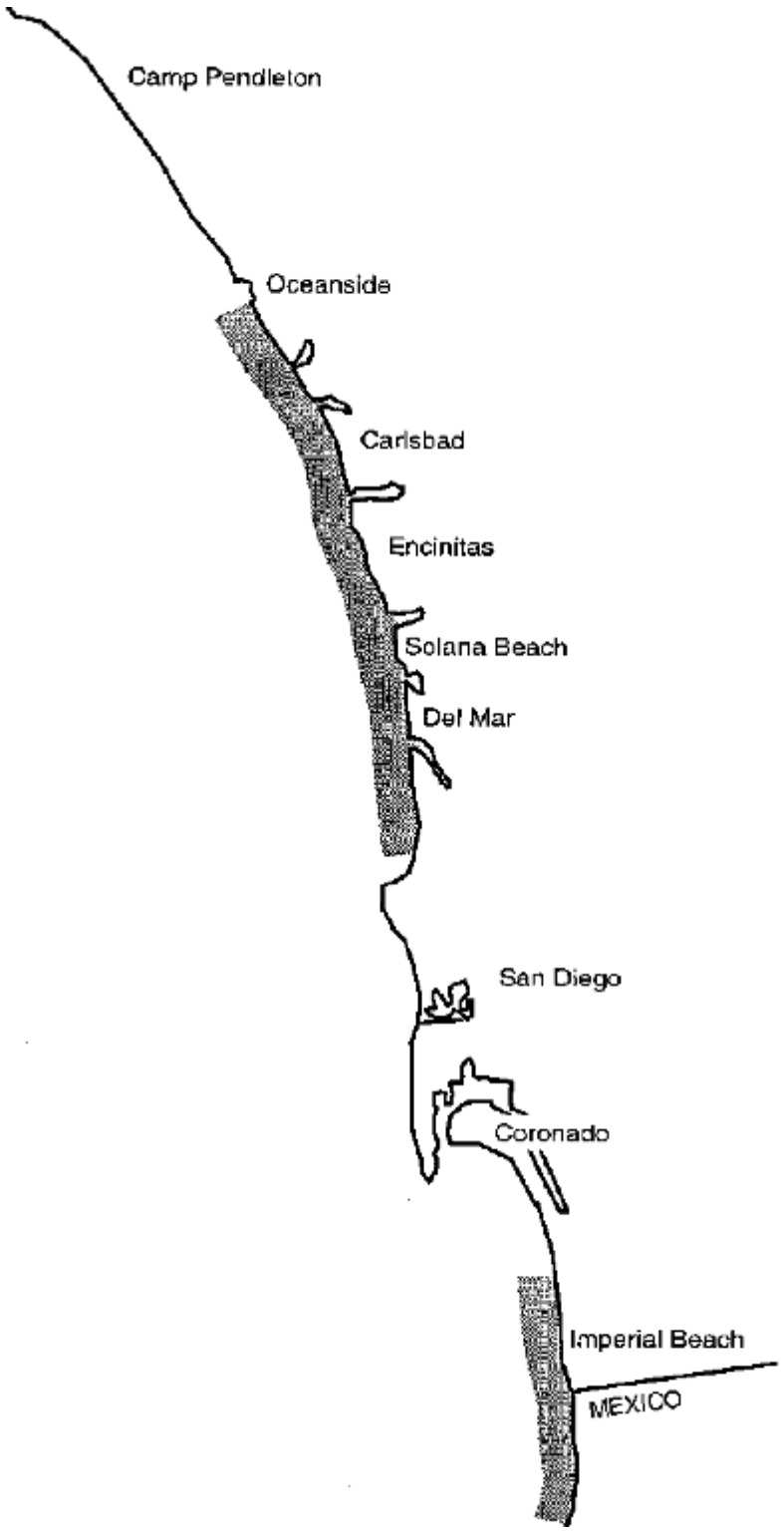
Mission, Ocean, and Coronado Beaches were not included in the SPS as highly erosive areas as they were wider in the early 1990s than at the present.

4.2 Beach Profiles

Beaches are commonly characterized by cross-shore surveys. The resulting profiles represent the elevation of the beach surface and nearshore seabed from the back of the beach to beyond the closure depth. The profile data show seasonal and long-term elevation changes in the beach and nearshore zone. These beach profile data provide information pertaining to the historic and existing sand volumes, beach elevations, and shoreline positions that are useful for planning and design.

SANDAG has recorded beach profiles throughout the Coastal RSM Plan area since 1995, and the USACE recorded profiles from 1934 to 1989. North and South County profile locations are shown in Figures 9 and 10, respectively**.** Profiles are presently recorded in April/May to measure post-winter conditions and in October to measure post-summer conditions. The beach profiles are used to assess seasonal changes in sand movement on- and offshore, shoreline position, beach retreat or advance, and closure depth. The latest profiles are assumed to represent existing conditions at each sand placement site.

Representative beach profiles from North County (Moonlight Beach), Central County (Mission Beach), and South County (Imperial Beach) are show in Figures 11, 12, and 13, respectively**.** The profiles tend to be very similar as the sediment grain sizes between the littoral cells show



Source: SANDAG Shoreline Preservation Strategy 1993

Figure 8 – SANDAG Shoreline Erosion Problem Areas

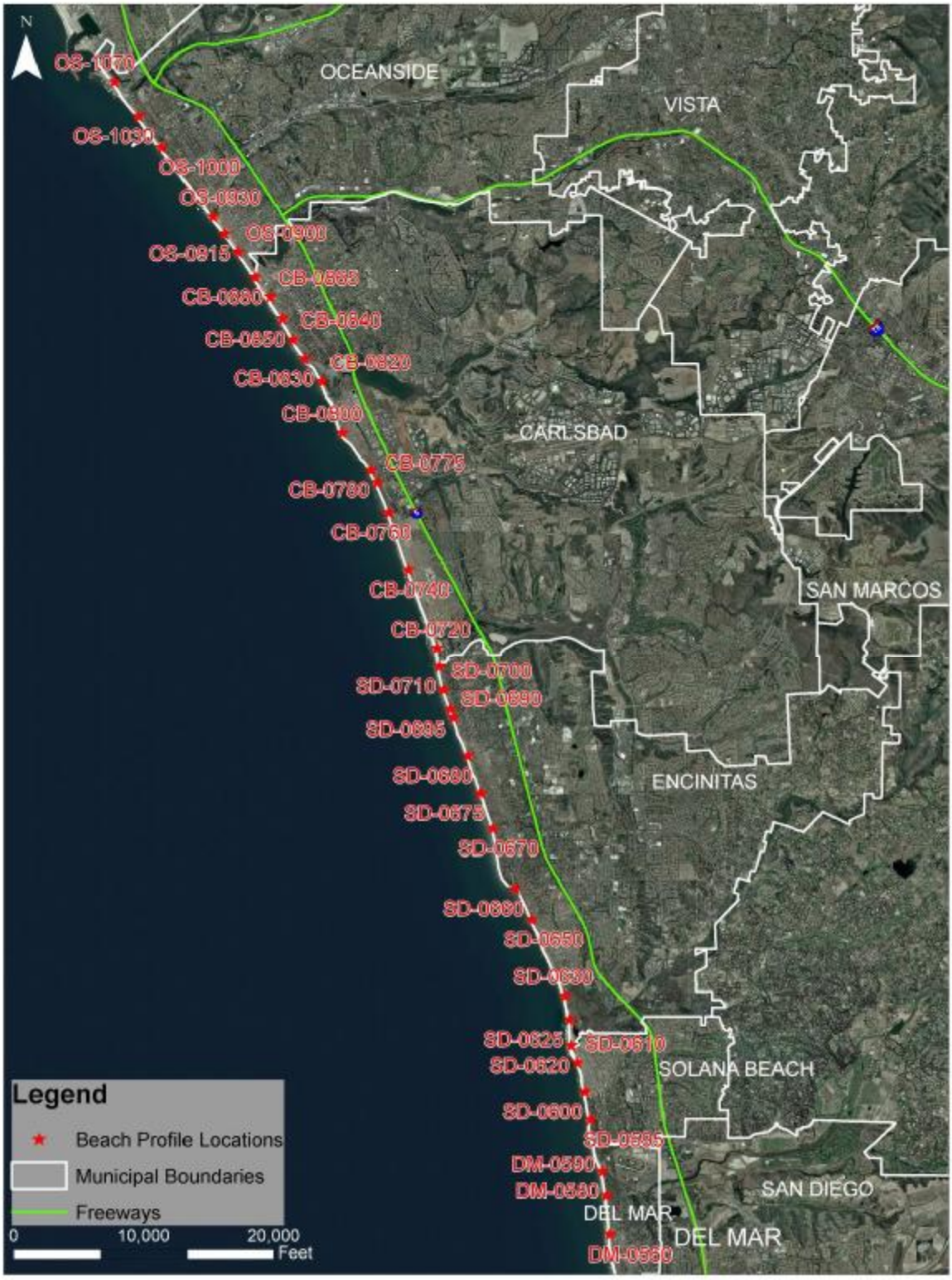
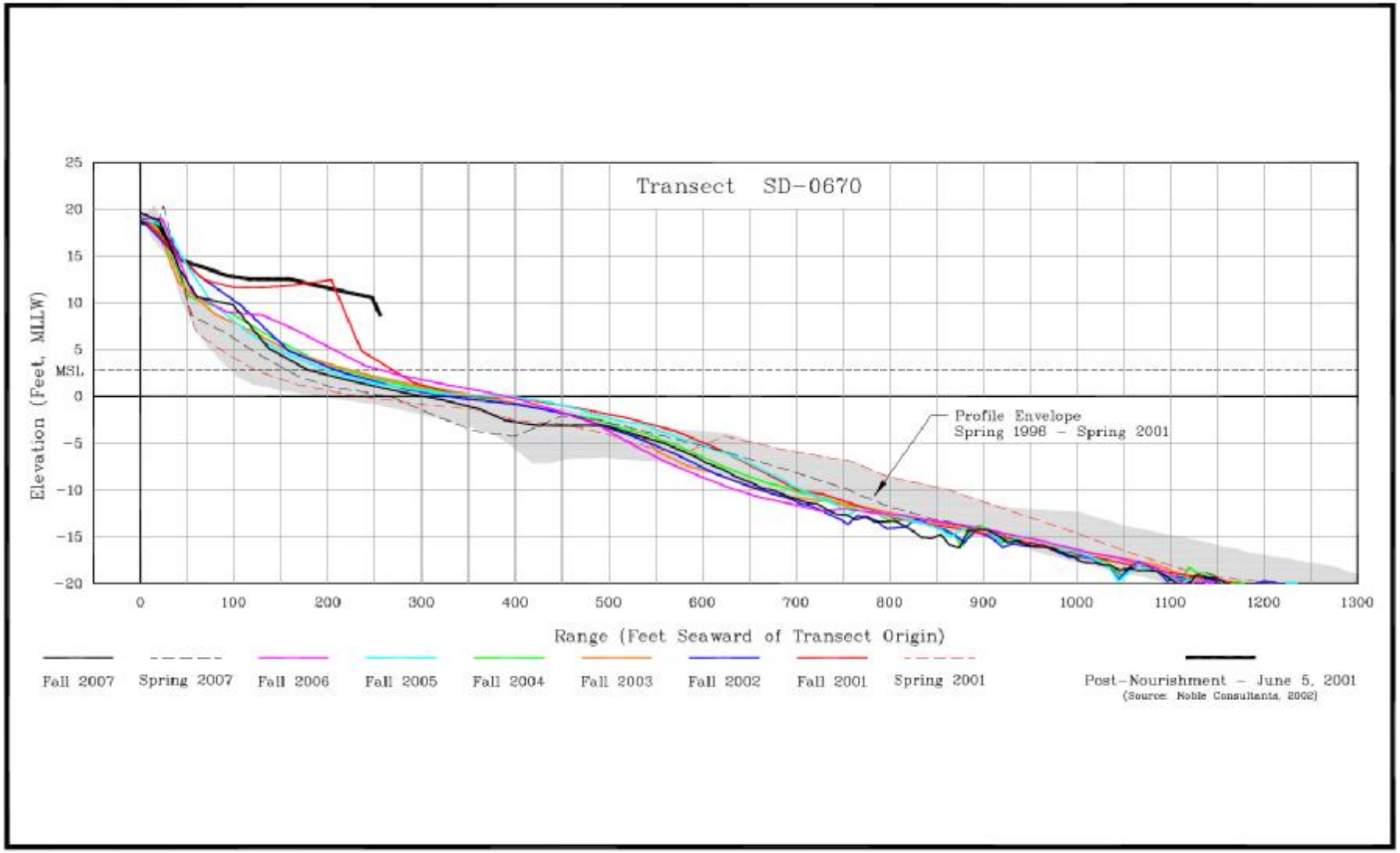


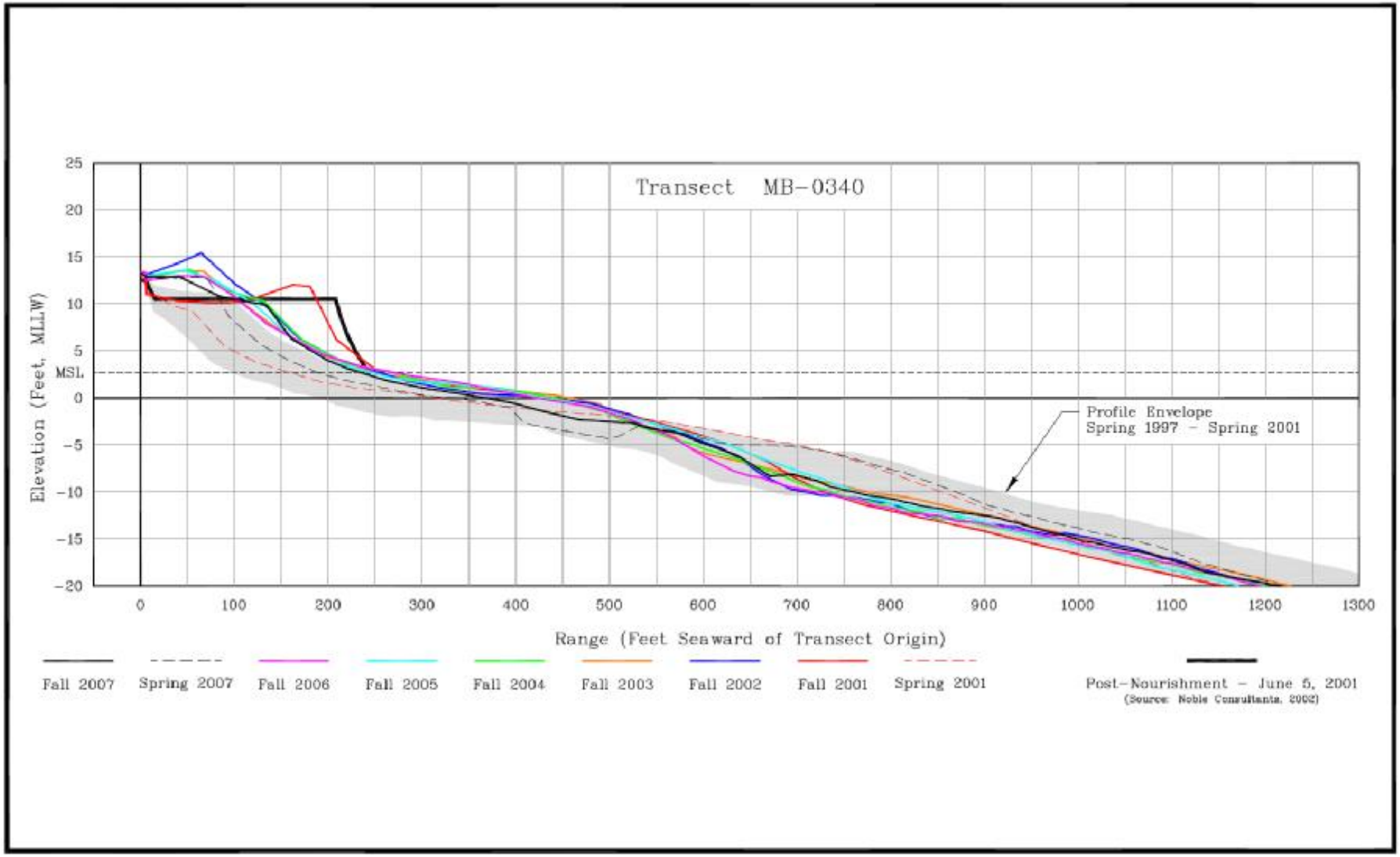
Figure 9 – Beach Profile Locations (North County)

Figure 10 – Beach Profile Locations (Central and South County)



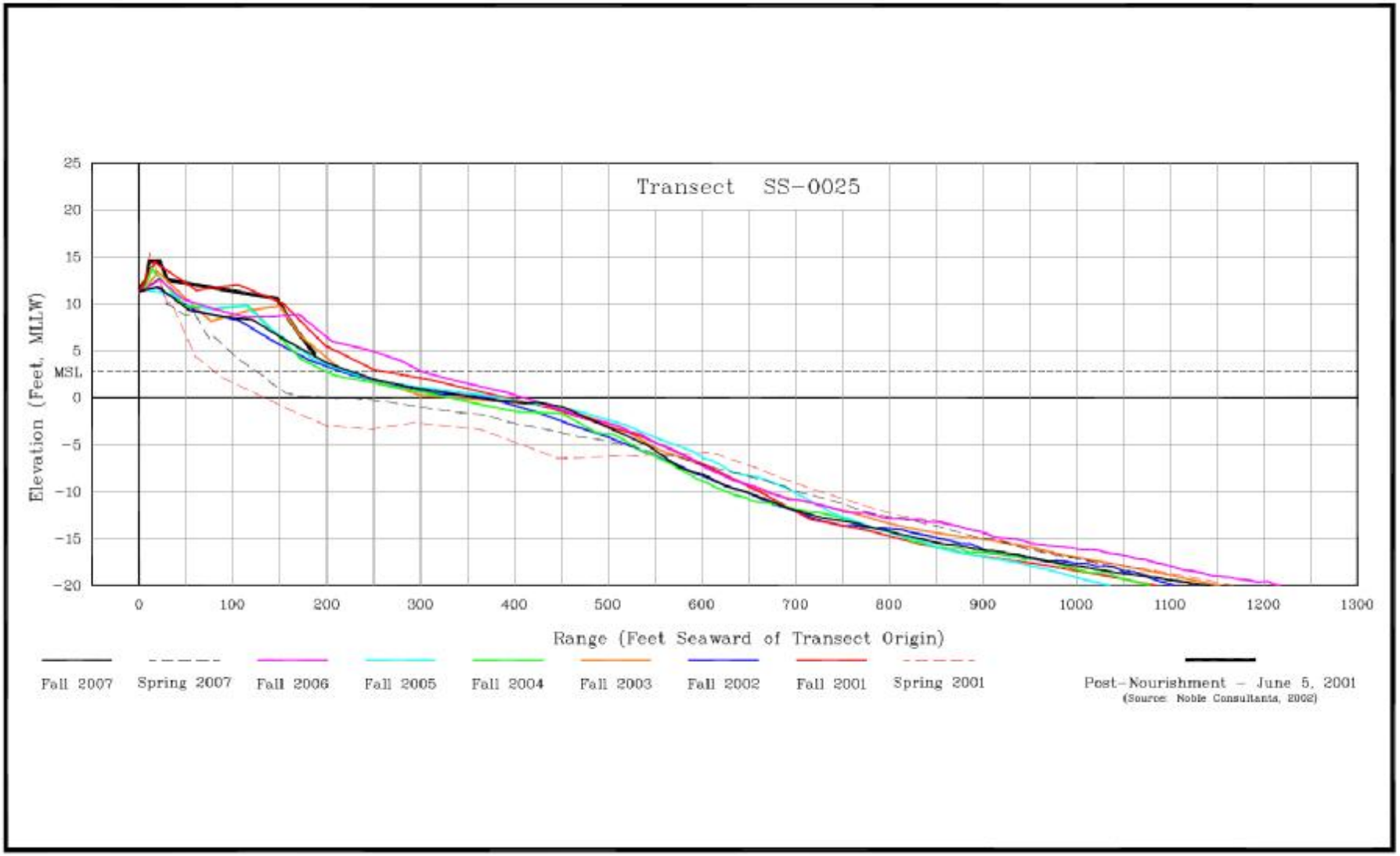
Source: Coastal Frontiers, 2008

Figure 11 – Beach Profiles for Moonlight Beach (North County)



Source: Coastal Frontiers, 2008

Figure 12 – Beach Profiles for Mission Beach (Central County)



Source: Coastal Frontiers, 2008

Figure 13 – Beach Profiles for Imperial Beach (South County)

little variance because the inland geology is fairly uniform throughout the region's watersheds, and wave conditions and energy imposed on the profile locations are similar throughout the region.

Depths to the closure of the profiles, or the point at which seasonal changes are no longer discernible, are similar throughout the region (Table 3) (Coastal Frontiers 2007). The slopes of beach profiles out to the closure depth are similar for each site, with a slightly steeper slope in North County than Central and South County.

Table 3 – Beach Profile Data for Representative Beaches

Beach	Profile Designation	Depth of Closure (Feet, to MLLW)	Beach Profile Slope Ratio	Percent Slope
Moonlight Beach	SD-0670	-29 feet	1:34	2.9
Mission Beach	MB-0340	-30 feet	1:40	2.5
Imperial Beach	SS-0025	-27 feet	1:38	2.6

MLLW: Mean Lower Low Water

The envelopes of the beach profiles show seasonal and long-term extremes in profile elevations, from lower elevations in severe winters to higher elevations during quiet periods and summer. Post-beach nourishment profiles are shown on the figures to depict their elevations after implementation of RBSP I.

4.3 Existing Coastal Sediment Quality

Beach sand data were collected for individual coastal cities in support of opportunistic beach fill programs, and for SANDAG as part of the SCOUP I and II Plans (Moffatt & Nichol 2006 and 2008, respectively). The SCOUP I provided guidance and protocol for using opportunistic beach fill as nourishment, and implemented a test pilot program at one location in the region (South Oceanside). Several other SCOUP programs evolved from that initial effort, resulting in SCOUP II, which served to initiate opportunistic beach fill programs at Encinitas, Solana Beach, Coronado, and Imperial Beach. The City of Carlsbad also has an approved opportunistic beach fill program in place that was created separately from the SCOUP efforts and is consistent with the SCOUP approach.

As required for these programs, the envelope of existing sand grain sizes was developed to identify the appropriate gradations that characterize suitable nourishment material for each potential receiver site. Candidate beach fill material is then assessed for suitability against the composite gradation envelope developed for the specific receiver site. Composite gradation envelopes have been developed for seven receiver site locations throughout North and South County. Figures in Appendix C show composite grain size envelopes for Oceanside, Carlsbad, Encinitas, Solana Beach, Coronado, Imperial Beach, and the beach at Border Field State Park near the Tijuana Estuary (Tijuana Estuary South Beach in Table 2), respectively.

Sand has grain size diameters ranging from 0.074 (very fine) to 4.0 millimeters (mm) (coarse). Most of the region's beach sand is fine to medium in grain size. North County beaches tend to have slightly coarser sand than do South County beaches, but the difference is minor and they are still similar to each other. Native beach sand in San Diego North County has a median grain size (the mid-point of the gradation range of the material) of between 0.25 and 0.30 mm. The median sand grain size at South County is between 0.20 and 0.25 mm. In winter, cobble can replace sand at many beaches.

Previous data were also collected by the USACE (1984) and Woodward-Clyde Consultants (1998). Their data show that the mean (not to be confused with the median) grain size of native beach sand at these receiver beaches varied, but tended to center on approximately 0.22 millimeters (mm) which is considered fine-grained sand.

4.3.1
Grain Size Homogeneity

Homogeneity is a measurement of how similar the grains in a sample are in size. Heterogenous indicates that grain sizes may range very broadly from very fine to very coarse. When sand exists on the region's beaches, it is fairly homogeneous as shown in Appendix C. Cobbles periodically exist in addition to sand at some beaches during the winter season, except at Coronado, Mission Beach and Ocean Beach.

Grain size is an indirect indicator of potential chemistry. Homogenous sands have less ability to retain contaminants than do clays and silts. The finer-grained materials contain ionic charges, which attract and hold onto contaminants. The beaches are mainly composed of sand and therefore unlikely to be contaminated. Testing for chemistry at beach receiver sites has not been required for previous permit applications for nourishment, and is not anticipated to be required for future permit phases of projects spawned from this Coastal RSM Plan during future permit phases of this project.

4.3.2
Grain Size Range

References to sand grain size in the previous discussion refer to the high, dry beach area. This is the area that is visible and used by people for recreation, and serves as shore protection for backshore property infrastructure. However, sand grain sizes range more broadly along the receiver site profile from the high dry beach (elevation up to +10 feet relative to MLLW) out to the depth of closure (elevations of approximately -30 feet relative to MLLW). The coarsest sands exist at the highest portion of the beach profile and in the surf zone. The finer sands and other particles (silts and clays) exist on the lower portions of the beach profile, from depths of between approximately -10 feet and -30 feet relative to MLLW. The percentage of fine-grained sediments at lower areas of the beach profile can be up to 35 percent or more. The percentage of fine-grained sediments located within the higher portion of the beach profile is typically below 5 percent.

4.3.3
Sediment Color

Sediment color has been an issue for certain previous projects using upland sand. The color of existing beach sand in the region is basically beige with some areas of darker-colored materials that consist of mica. Fletcher Cove in Solana Beach and beaches at the base of Torrey Pines bluffs near Black's Beach in San Diego sometimes possess very dark colored material. Remaining beaches in the region typically consist of the lighter-toned beige color.

Dredged material and many upland source materials initially are typically darker colored than the receiving beach. When placed in the surf zone, the material is washed and reworked by waves resulting in sand similar in appearance to the receiving beach. Color was addressed in the SCOUP I (Moffatt & Nichol 2006) by requiring material from upland to be placed below the mean high tide line so that tides and waves would rework the sediment. This reworking process adequately distributes and disperses the sediment such that source sand with a different color than the receiving beach is no longer discernible.

Resource agencies have been less concerned about material color in the past because of more extensive use of dredged material for historic beach fill rather than upland material. Strong public reaction occurred in 1996 when red-colored upland sand was placed over the white sand beach at Ponto Beach in Carlsbad, California (Sherman, et al. 1998). Permit agencies have informally indicated that their only criteria for color is to reasonably match the color of the receiving beach after reworking by waves.

4.4 Existing Coastal Habitat Constraints

Existing coastal habitat constraints are described below as an overview, a summary, and for impact considerations.

4.4.1
Overview of Coastal Habitats

The coastline of San Diego County includes a variety of habitats including sandy beaches and subtidal, nearshore and offshore reefs, estuarine lagoons, and larger embayments. In addition, coastal dune/strand and eelgrass meadows locally occur along the coast. Within these coastal areas, biota differ among sandy, rocky, and vegetated habitats. Generally, rocky and vegetated marine habitats are rarer in occurrence and support greater biological diversity than soft-bottom habitats. Federally designated habitats of particular concern (HAPCs) include estuaries, canopy kelp, seagrass, and rocky reefs. Other sensitive resources include endangered and threatened species protected under the Endangered Species Act (ESA).

The Marine Life Management Act (MLMA) was passed in 1999 by the California Legislature to ensure the conservation, restoration, and sustainable use of California's marine living resources (http://www.fgc.ca.gov/mlma/mlma.html). The MLMA requires that Fishery Management Plans (FMPs) form the primary basis for managing the state's marine fisheries. The California DFG prepared a Master Plan for developing FMPs that lists over 375 species of fish, invertebrates, and plants managed by the state (www.dfg.ca.gov/marine/masterplan). Two FMPs have been

prepared by DFG, including the Nearshore FMP, which covers 19 species of finfish, and the White Seabass FMP (www.dfg.ca.gov/marine). Several other state-managed species are covered in federal FMPs that are regulated by the National Marine Fisheries Service (NMFS), including: Coastal Pelagic Species, Highly Migratory Species, Pacific Coast Groundfish, and Pacific Coast Salmon (www.pcouncil.org).

Also in 1999, the California State Legislature adopted the Marine Life Protection Act (MLPA), which requires the state to design and manage a network of marine protected areas in order to, among other things, protect marine life and habitats, marine ecosystems, and marine natural heritage, as well as improve recreational, educational and study opportunities provided by marine ecosystems (http://www.dfg.ca.gov/mlpa/). This initiative includes evaluation and/or re-design all existing state marine protected areas (MPAs) and potentially the creation of new MPAs. MPA designations include: state marine reserve (SMR), state marine park (SMP) and state marine conservation area (SMCA). The state is divided into three coastal region study areas for this process. The planning process for the south coast study region, which ranges from Point Conception to the border with Mexico, began in mid-2008 and is currently ongoing. The outcome of this planning effort for the San Diego region may be an important consideration of future sand management activities.

Section 4.4.2 summarizes sensitive resource constraints, including managed species (e.g., grunion, lobster) for the San Diego region, while impact considerations are discussed in Section 4.4.3.

4.4.2
Summary of Biota Constraints

Figures 14 to 21 illustrate locations of existing, historical, and proposed CRSM Plan sites with respect to biological constraints such as rocky vegetated reefs, surfgrass, lagoons, and nesting or wintering areas of the California least tern (*Sterna antillarum browni*) and western snowy plover (*Chardrius alexandrinus nivosus*). Vegetated reefs are distinguished according to dominant vegetation (i.e., surfgrass, understory algae, giant kelp). The extent of kelp canopy can vary each year depending on environmental conditions; therefore, recent and historical locations of kelp canopies are provided on the figures.

Other sensitive resources occur or have the potential to occur, but are not shown on the figures. For example, the endangered California brown pelican is a visual predator of fish in the nearshore and rests on structures (e.g., jetties, floats, docks) and rocks away from human disturbance. Several species of abalone (*Haliotis* spp.) that are endangered, candidate listed species, or otherwise protected occur in association with some of the more developed nearshore reefs in the County. Endangered whales and other marine mammals (seals, sea lions, dolphins, and porpoises) are also afforded protection under the Marine Mammal Protection Act.

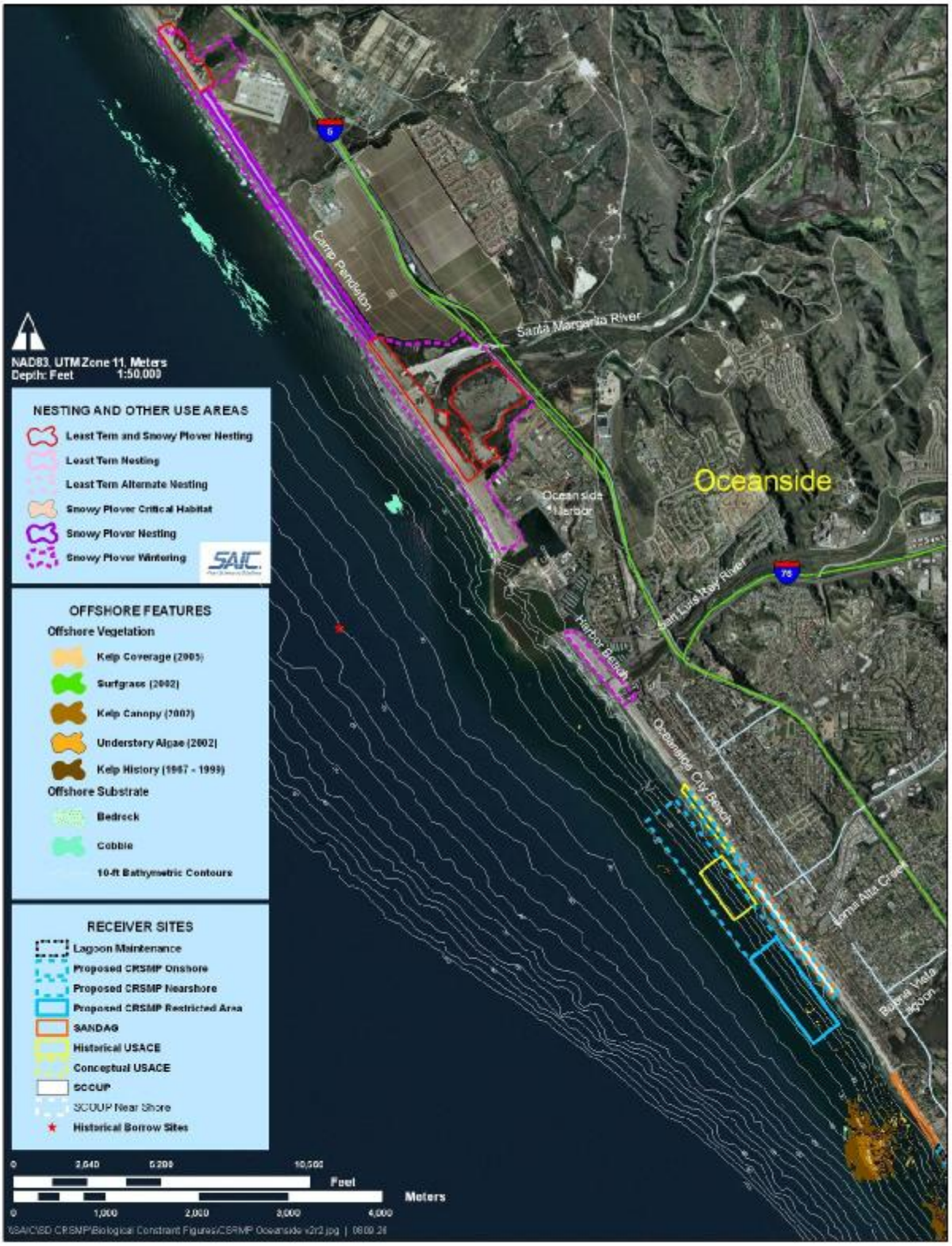


Figure 14 - Sensitive Biological Resource Areas in the Vicinity of Oceanside Sediment Management Areas

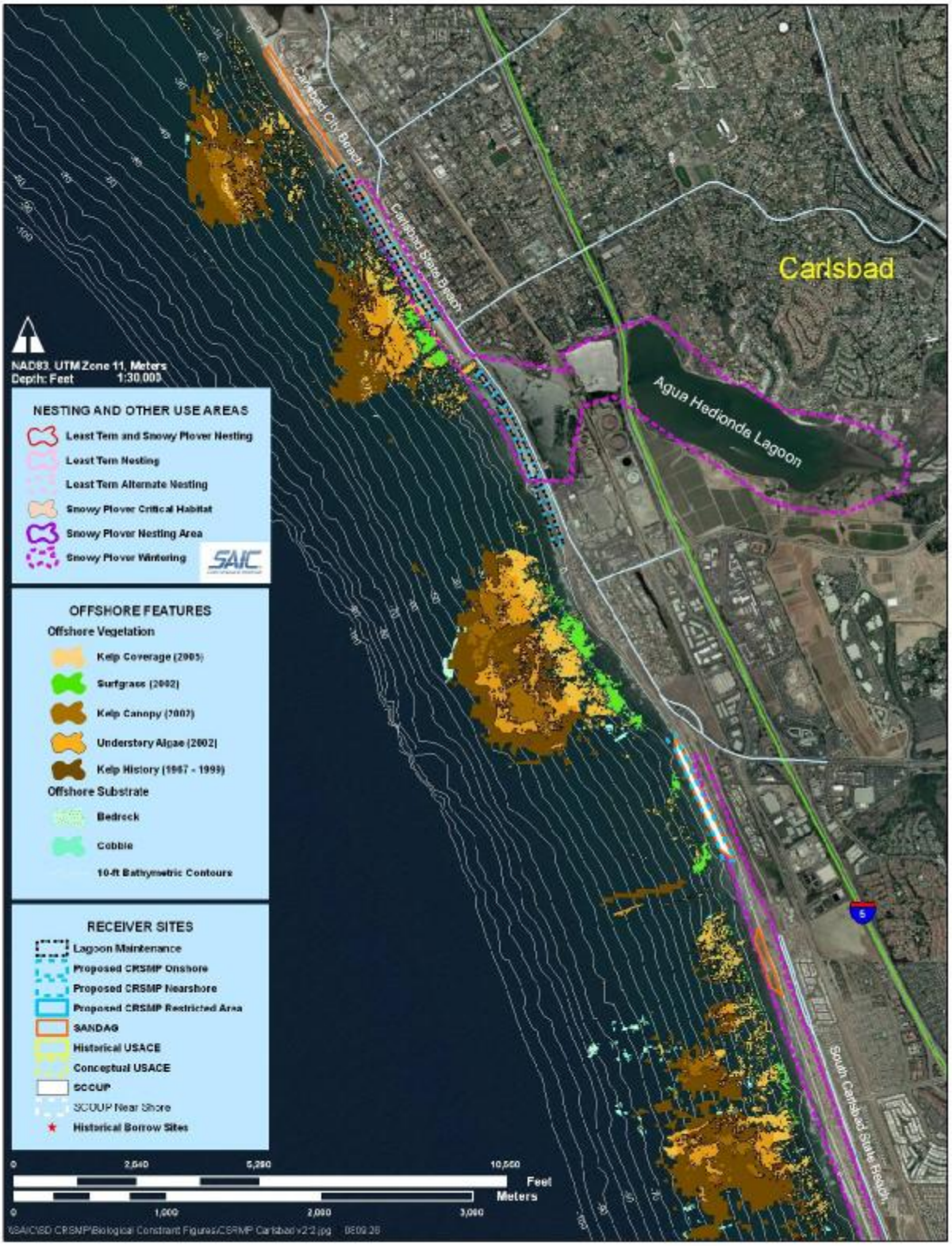


Figure 15 - Sensitive Biological Resource Areas in the Vicinity of Carlsbad Sediment Management Areas

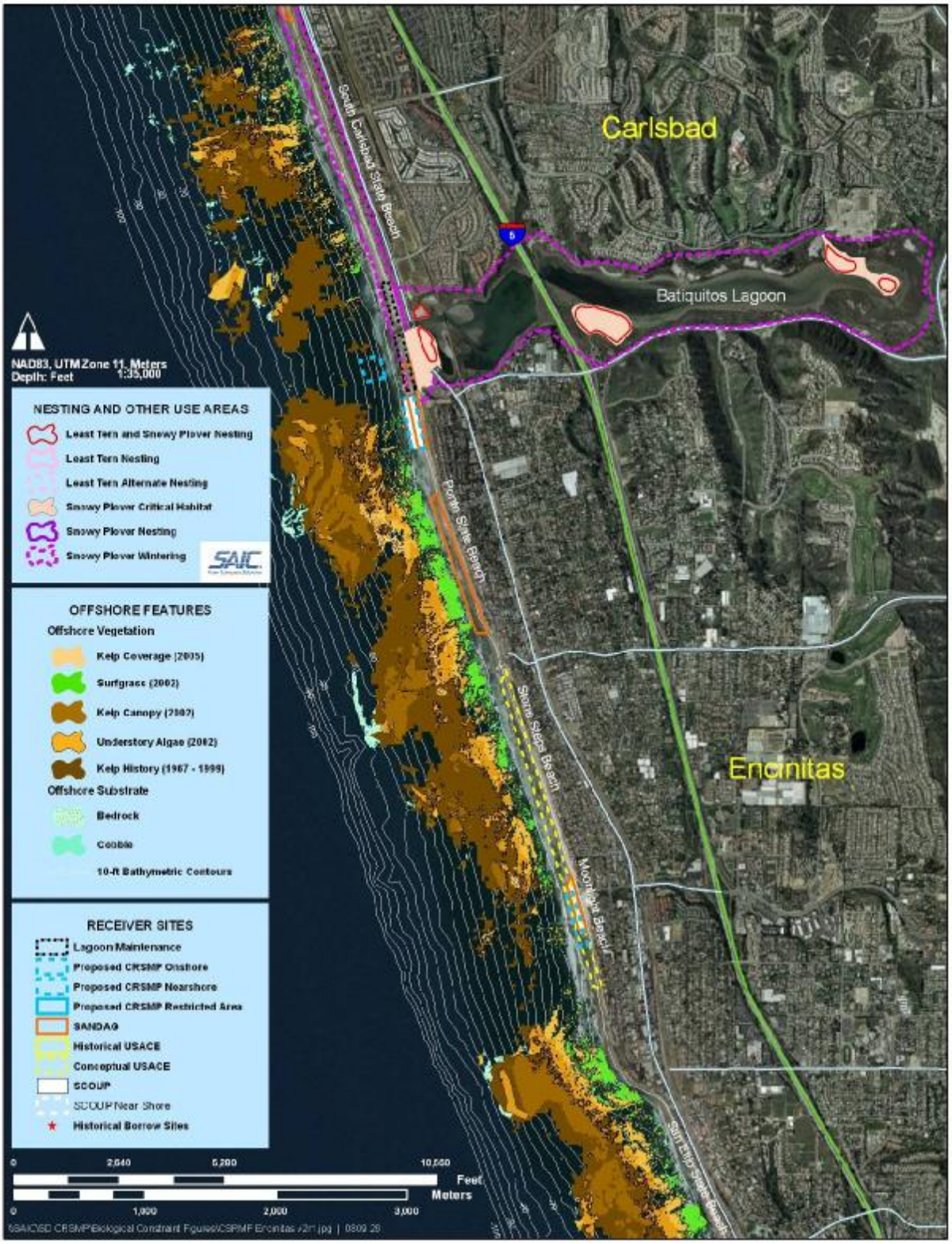


Figure 16 - Sensitive Biological Resource Areas in the Vicinity of Carlsbad and Encinitas Sediment Management Areas

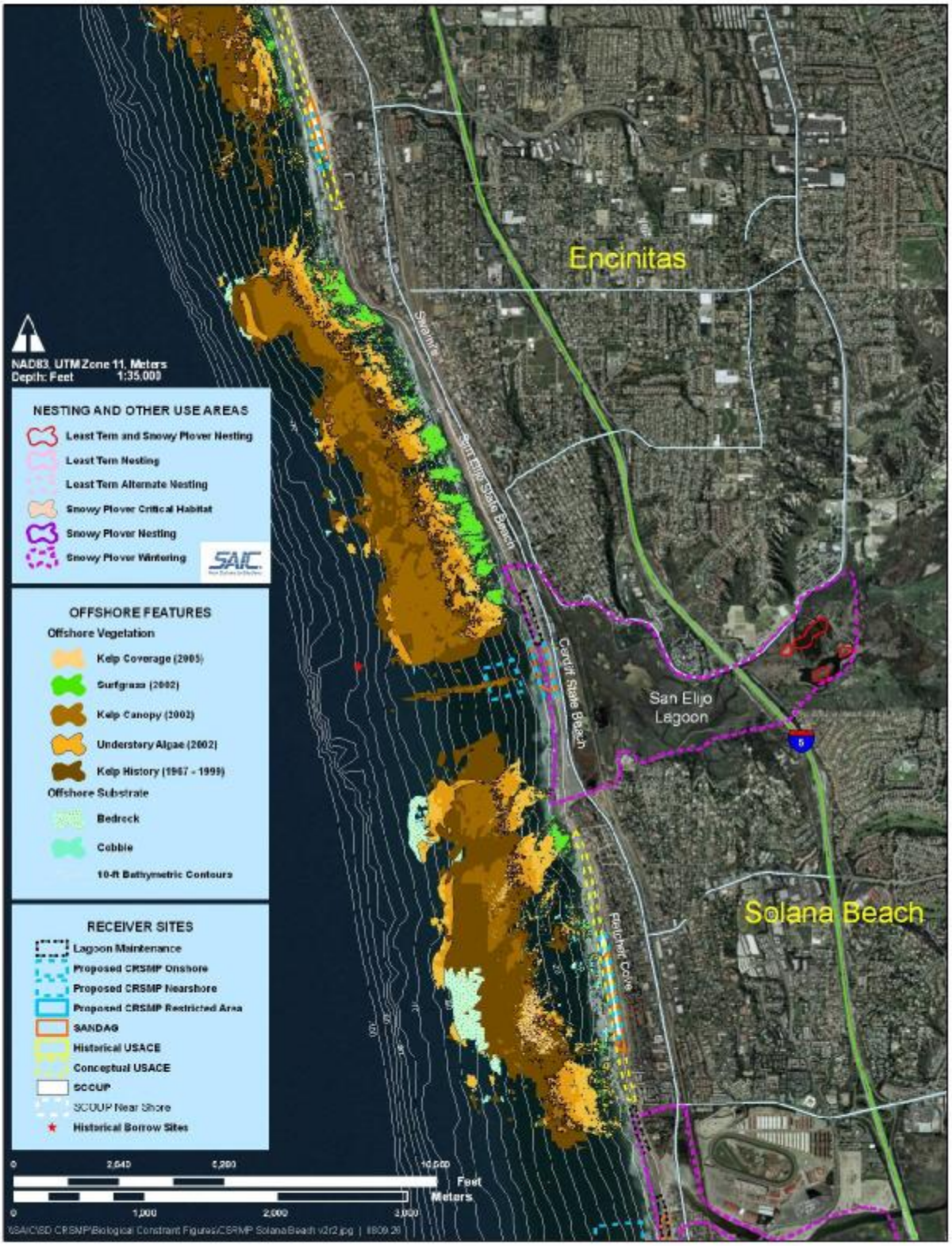


Figure 17 - Sensitive Biological Resource Areas in the Vicinity of Encinitas and Solana Beach Sediment Management Areas

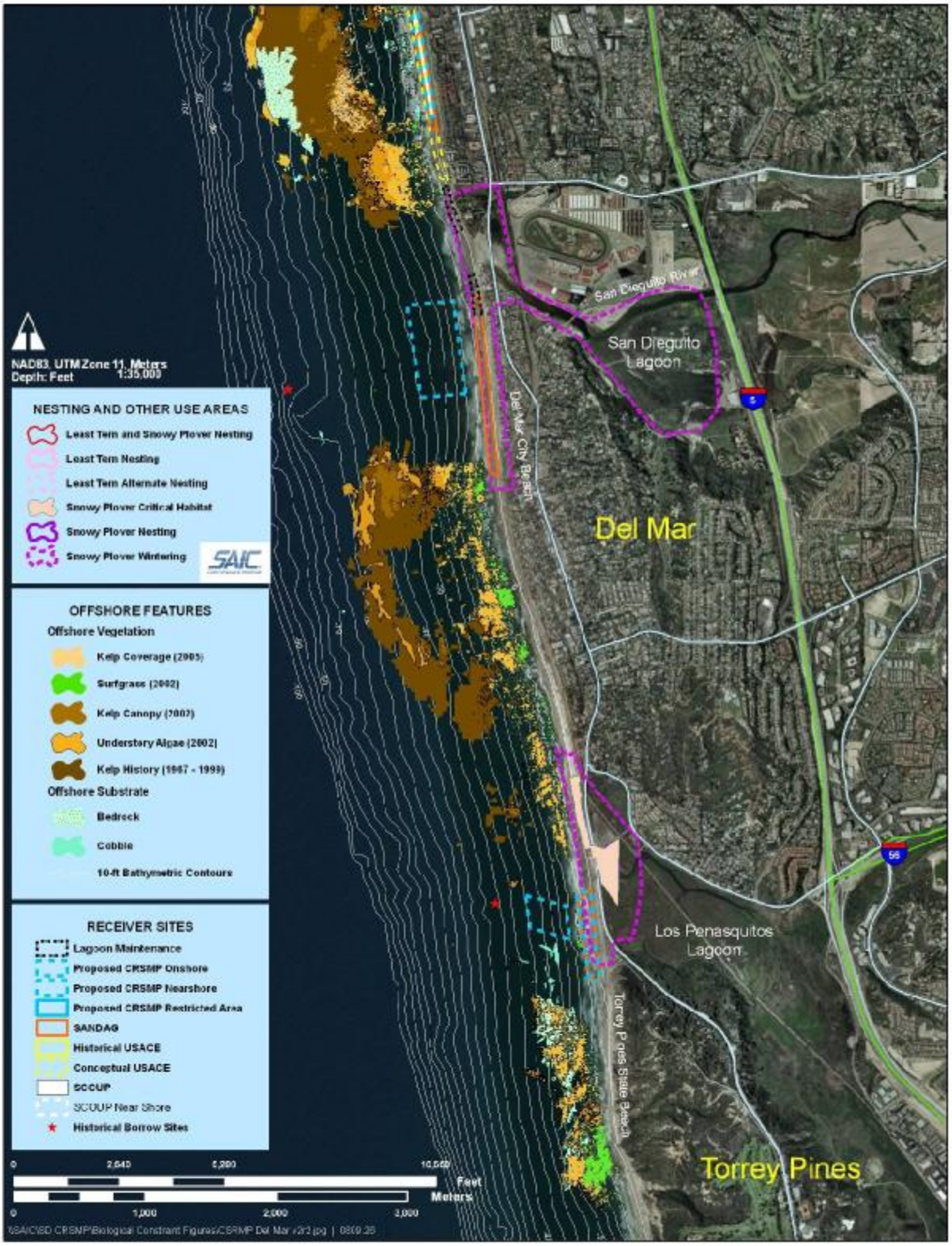


Figure 18 - Sensitive Biological Resource Areas in the Vicinity of Del Mar and Torrey Pines Sediment Management Areas

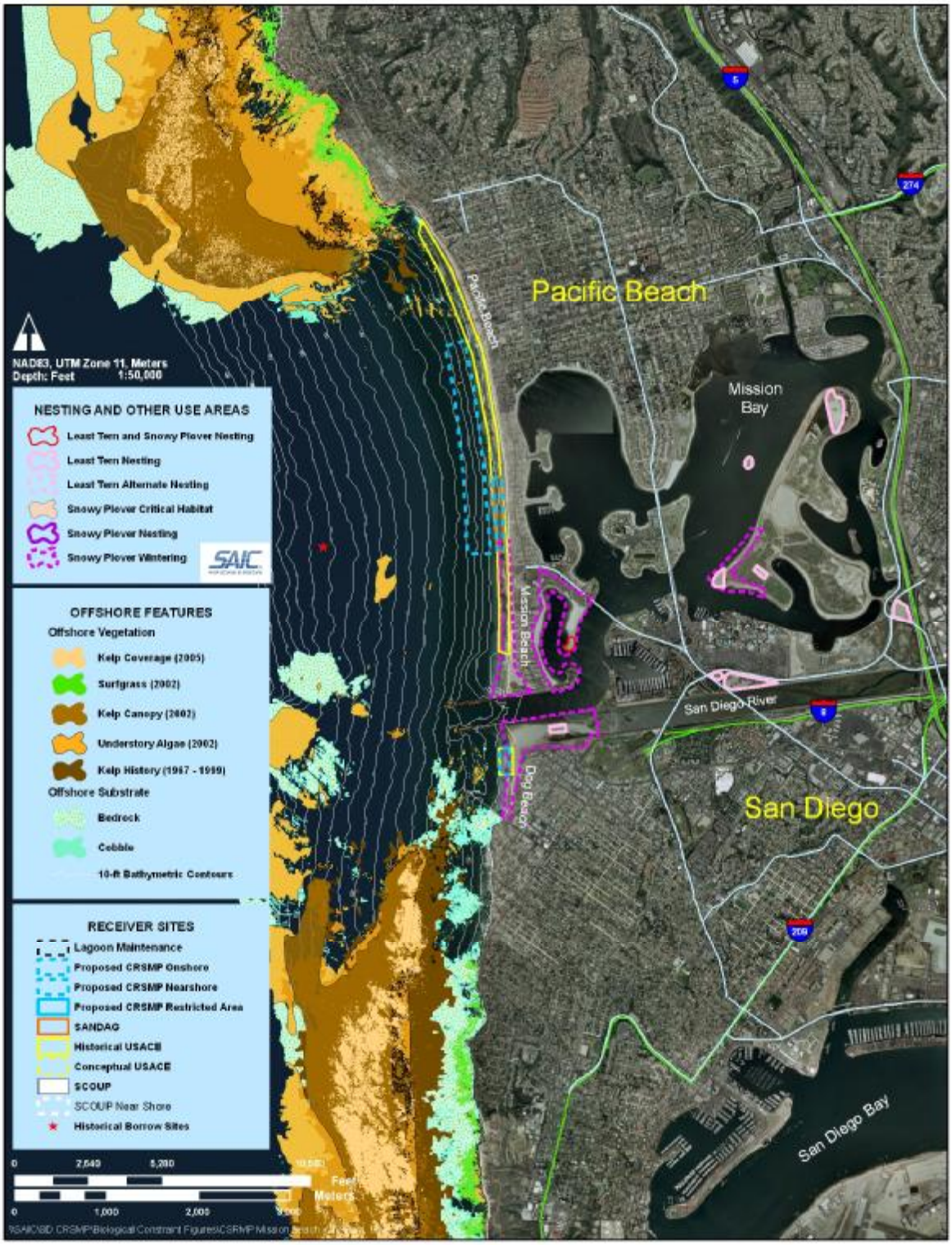


Figure 19 - Sensitive Biological Resource Areas in the Vicinity of Mission Beach Sediment Management Areas

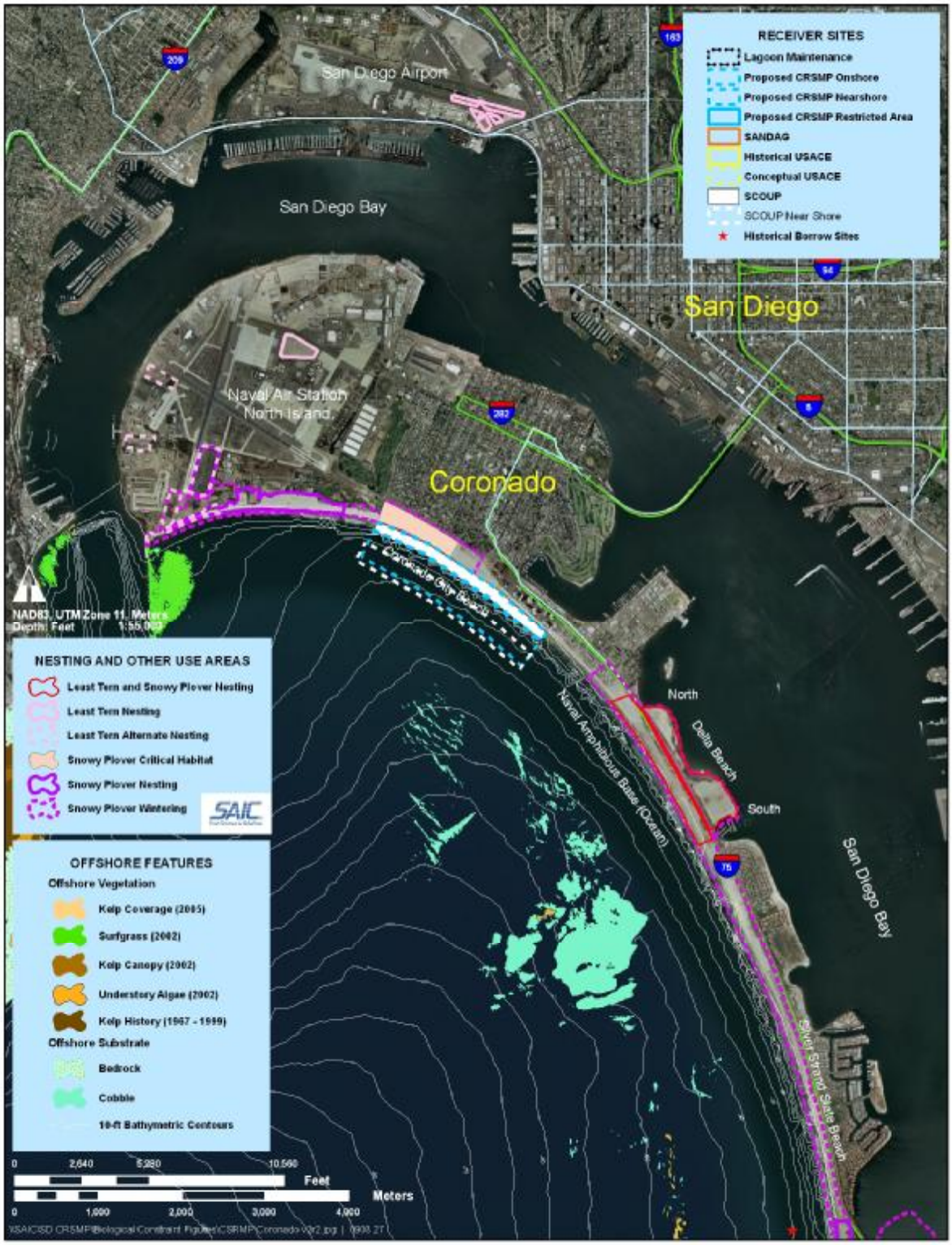


Figure 20 - Sensitive Biological Resource Areas in North San Diego Bay in the Vicinity of Coronado Sediment Management Areas

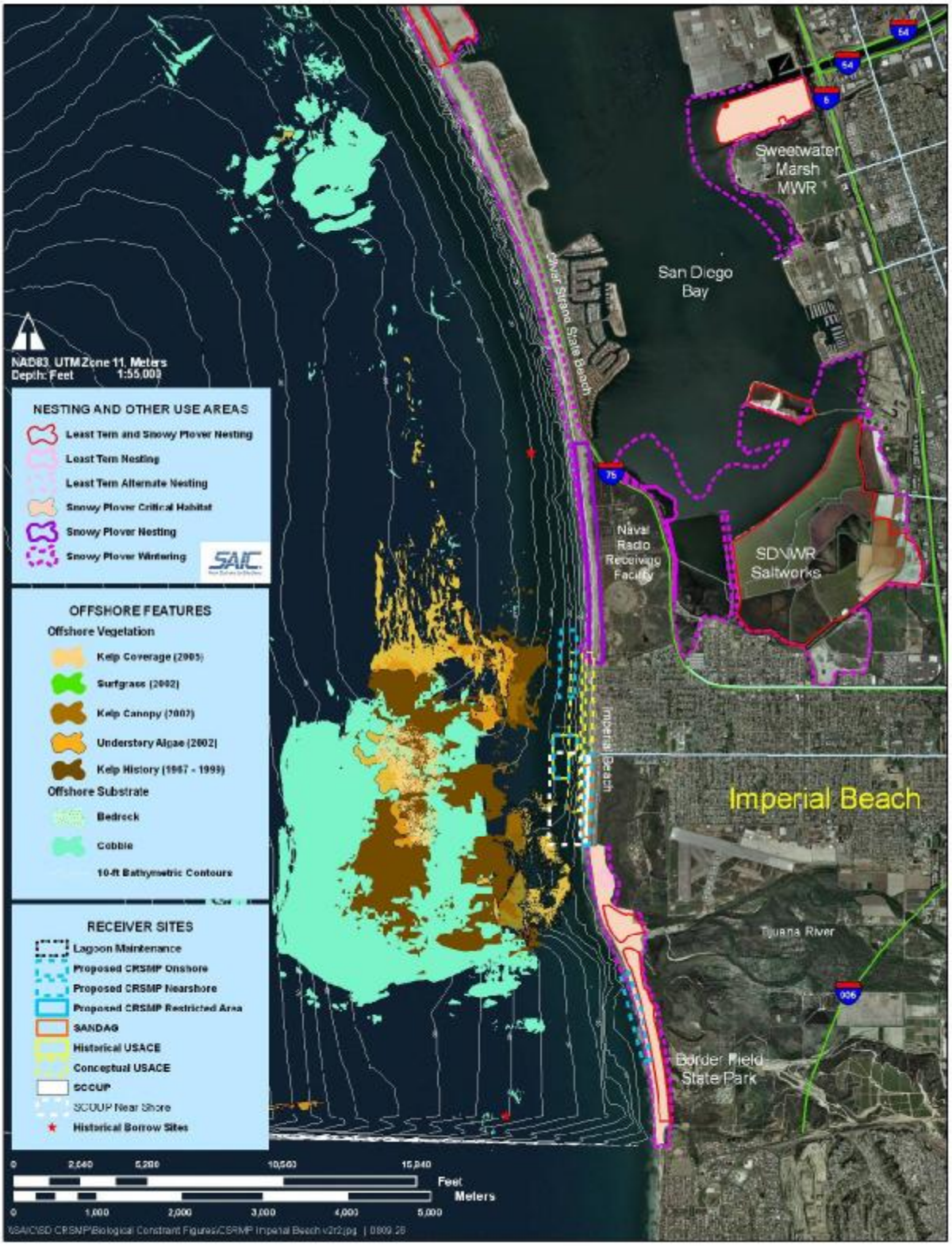


Figure 21 - Sensitive Biological Resource Areas in the Vicinity of Imperial Beach Sediment Management Areas

Several state-managed species of commercial or recreational importance are associated with hard bottom or vegetated habitats such as California spiny lobster (*Panulirus interruptus*) and sea urchins (*Stronglyocentrotus* spp.). Management regulations associated with protection of hard bottom and vegetated HAPCs generally are protective of associated species. Several other state-managed species are associated with sandy beach or subtidal habitats. For example, California grunion (*Leuresthes tenuis*) spawns on sandy beaches of suitable habitat quality in the region. Pismo clam (*Tivela stultorum*) may occur in localized beds in subtidal sands and in the intertidal zone of some beaches.

Generally, sensitive habitats, sensitive species, and areas of concentration of state-managed species represent constraints for sand management activities. Avoidance of direct impacts is a primary consideration. In addition, distances may be specified by permits to protect such resources from indirect impacts such as increased noise, turbidity, and other human disturbances associated with sand management activities.

Table 4 summarizes the regional distribution of habitats in San Diego County, and sensitive resource constraints in the vicinity of potential sand receiver sites are listed in Table 5. Other sensitive aquatic resources (e.g., Pismo clam beds) potentially occur in the vicinity of receiver sites; however, there is a lack of available information on their occurrence. A more detailed summary on proximity of selected sensitive resource to potential receiver sites is given in Appendix E.

Table 4 - Regional Distribution of Habitats in San Diego County

Habitat	Relative Occurrence	San Diego County
§ Coastal Dune and strand	§ Localized areas	§ North of Santa Margarita River, remnants near lagoons (e.g., Batiquitos, San Elijo, San Dieguito, Los Penasquitos), Coronado Beach, Silver Strand, Imperial Beach
§ Sandy Beach	§ Majority of shoreline	§ Majority of shoreline
§ Sandy Subtidal	§ Majority of nearshore	§ Majority of nearshore
§ Nearshore Reefs	§ Localized areas	§ Limited Oceanside; localized off Carlsbad, Encinitas, Solana Beach, Del Mar, Torrey Pines, La Jolla, Pacific Beach, Ocean Beach, Sunset Cliffs, Point Loma, Imperial Beach
§ Offshore Cobbles/Rocks	§ Localized areas	§ Oceanside, Torrey Pines, Coronado, Imperial Beach
§ Surfgrass Beds	§ Localized areas on rocky intertidal and subtidal nearshore reefs	§ Carlsbad, Encinitas, Solana Beach, Del Mar, Torrey Pines, La Jolla, Pacific Beach, Ocean Beach, Sunset Cliffs, Point Loma

(cont.)

Habitat	Relative Occurrence	San Diego County
§ Eelgrass Meadow	§ Localized areas in bays and sheltered coastal areas	§ Aqua Hedionda Lagoon, Batiquitos Lagoon, Mission Bay, San Diego Bay, Zuniga Point
§ Kelp Forests/Beds	§ Localized areas on subtidal nearshore and offshore reefs	§ Carlsbad, Encinitas, Solana Beach, Del Mar, Torrey Pines, La Jolla, Pacific Beach, Ocean Beach, Sunset Cliffs, Point Loma, Imperial Beach
§ Lagoons	§ Six	§ Buena Vista, Aqua Hedionda, Batiquitos, San Elijo, San Dieguito, Los Penasquitos
§ Rivers	§ Four	§ Santa Margarita, San Luis Rey, San Diego, Tijuana
§ Bays/Harbors	§ Three	§ Oceanside, Mission Bay, San Diego Bay

Table 5 - Sensitive Biota Near Sediment Management Receiver Sites

ID	Receiver Sites	Nearshore Reef	Surfgrass	Offshore Kelp Bed	Other Rocks ®, Pier(P), or Outfall Pipeline (O)	Coastal Dune/Strand	Bay/Lagoon Inlet	California Grunion	Least Tern Nesting	Snowy Plover Critical Habitat	Snowy Plover Nesting	Snowy Plover Wintering
	Constraint Distance[1]	2640	2640	2640	[3]	0[2]	2640	0	3000	1500	1500	[3]
1.	South Oceanside onshore							√				
2.	South Oceanside nearshore*	√		√	R/P							
3.	North Carlsbad onshore	√	√	√			√	√				√
4.	Agua Hedionda onshore	√	√	√			√	√				√
5.	South Carlsbad onshore	√	√	√				√				√
6.	Batiquitos Beach onshore	√	√	√		√	√	√	√	√	√	√
7.	Batiquitos nearshore *	√	√	√			√		√			
8.	Leucadia onshore	√	√	√				√	√			
9.	Moonlight Beach onshore	√	√	√				√				
10.	Cardiff Beach onshore	√	√	√			√	√				√
11.	Cardiff nearshore*	√	√	√	O[+]		√					
12.	Solana Beach (Fletcher Cove) onshore	√	√	√				√				
13.	San Dieguito nearshore*	√		√	O[+]		√					
14.	San Dieguito onshore*	√		√			√	√				√
15.	Del Mar onshore	√	√	√			√	√				√

(cont.)

ID	Receiver Sites	Nearshore Reef	Surfgrass	Offshore Kelp Bed	Other Rocks ®, Pier(P), or Outfall Pipeline (O)	Coastal Dune/Strand	Bay/Lagoon Inlet	California Grunion	Least Tern Nesting	Snowy Plover Critical Habitat	Snowy Plover Nesting	Snowy Plover Wintering
16.	Torrey Pines onshore	√	√	√		√	√	√		√		√
17.	Torrey Pines nearshore*	√		√	O		√					
18.	Mission Beach onshore							√	√			√
19.	Mission Beach nearshore*	√		√	O[+]				√			
20.	Ocean Beach onshore*	√		√	P		√	√	√			√
21.	Coronado Beach onshore					√		√		√	√	√
22.	Coronado Beach nearshore											
23.	Imperial Beach onshore	√		√		√		√	√	√	√	
24.	Imperial Beach nearshore (N)	√		√	P							
25.	Imperial Beach nearshore (S)	√		√	P, R[++]				√			
26.	Tijuana Estuary onshore					√	√	√	√	√	√	√

Sources: Figures 14-21;
[+] = MEC 2000; [++] SAIC 2009; * = new site that has not received prior sand placement
Constraint Distance Notes:
[1] = Constraint distance based on RGP 67 guidance or interpretation of guidance (i.e., although no specific distance was specified for reef, surfgrass, or kelp areas, monitoring requirements for turbidity is specified within ½ mile offshore and downcoast of sand placement).
[2] = No reported criteria; constraint distance based on avoidance of direct impact (i.e., 0 ft)
[3] = No reported criteria; constraint distance to be based on site- or project-specific conditions

4.4.3
Biota Impact Considerations

Several types of impact concerns on biota have been identified in reviews of dredging or beach nourishment (Hirsch, et al. 1978; Wright 1978; Naqvi and Pulllen 1983; LaSalle, et al. 1991; NRC 1995; Greene 2002). Most are associated with the construction phase of sand management and relate to the potential to damage sensitive habitats or interfere with critical life functions of sensitive species from equipment, sand removal, or sand placement. CSMW's draft Biological Impacts Analysis report (Science Applications International Corporation or SAIC, in progress) contains an exhaustive review of potential impacts associated with sand management, as well as recommendations on how to minimize adverse impacts during planning and implementation of the project. Impact considerations from that report are presented below.

Several activities and/or measures may be taken during the pre-construction phase to minimize adverse effects associated with implementation of sand management projects. An important consideration during project design is to locate sand management project sites to avoid direct impacts to sensitive habitats and to allow sufficient buffer distances or volume limitations to minimize the extent or duration of impacts away from the site associated with noise, sedimentation, or turbidity. During the project phase an important permit requirement is testing to determine compatibility of source sediments with those of the receiver site(s). SCOUP programs that permit use of less-than optimum sands at certain sites within the region also specify sediment testing after construction to ensure evaluation and long-term protection of beneficial uses of sandy beach habitats. Depending of site conditions, focused pre-construction surveys may be necessary to support scheduling, limits of construction corridors in environmentally constrained areas, verification of habitat suitability for grunion spawning, or presence/absence of sensitive resources that would require implementation of additional mitigation measures during construction.

Potential impact considerations during the construction phase include:

- Burial or removal of sensitive habitat or biota;
- Removal or damage to sensitive habitats or biota from equipment operation (dredges, pipelines vehicles, vessels);
- Disturbance or interference with movement, foraging, or reproduction of sensitive species from equipment operation; and
- Turbidity or water quality degradation associated with dredging or sand placement to displace or interfere with foraging, respiration, recruitment, or reproduction of aquatic animals, or degradation of vegetated habitats.

After sand placement, impact concerns relate to recovery rates of soft-bottom habitat functions, and the potential for sand, moved by waves and currents, to become trapped or build up in sensitive habitat areas, if present nearby. Potential impact considerations after construction include:

- Compatibility of placed sands with existing sediments;
- Potential for alteration of hydrodynamics and habitat quality;
- Sedimentation and degradation of nearshore reefs;
- Sedimentation and degradation or loss of surfgrass beds;
- Sedimentation and degradation or loss of offshore kelp beds;
- Sedimentation that results in substantial shoaling or closure of lagoon inlets; and
- Sedimentation that increases the frequency or volume of maintenance dredging in lagoons or harbors.

Potential impacts may have adverse, beneficial, or no effect on habitats or species depending on timing of activities, magnitude of effect, or vulnerability or tolerance to disturbance. Consequently, locations of sensitive habitats and resources may constrain volume, schedule, or frequency of sand management activities. The following subsections summarize primary impact

considerations associated with selected sensitive habitats and resources of particular concern for coastal sand management activities in San Diego County.

Sandy Beach and Subtidal Habitats

The intertidal portion of sandy beaches is inhabited by a variety of invertebrates (e.g., worms, sand crabs, clams), which provide forage for shorebirds along the shore and fishes in the surfzone. California grunion uses suitable sandy beaches as spawning habitat. The threatened snowy plover forages, nests, and winters on certain beaches in the County (Table 5, Figures 14-21). Beaches also may be used as resting habitat for seabirds and pinnipeds (seals, sea lions).

Subtidal sands support a greater variety of invertebrates, which provide forage for bottom-associated fish. Generally, the diversity of invertebrate assemblages is less in the energetic surf zone and increases as the energy decreases with increasing distance offshore. Subtidal areas may vary in development of nearshore resources depending on physical conditions and disturbance frequency (e.g., near river outlets). Certain areas also may have unique resource concentrations (e.g., Pismo clam beds).

Shorebirds foraging at nourished San Diego beach
Photograph by Karen Green, SAIC

Many coastal fish species make inshore/offshore migrations, using shallows as spawning or nursery habitats (Cross and Allen 1993). For example, California halibut migrates inshore in late winter and early spring to spawn and remain in shallow waters until late fall and winter (Love 1996).

Sand placement in aquatic habitats will bury invertebrates with limited mobility and dredging removes sedentary invertebrates. Generally, invertebrate assemblages recover within a season in areas subject to frequent disturbance (e.g., beaches, areas subject to maintenance dredging); however, recovery may take substantially longer in less-disturbed habitats. Although sandy beach invertebrates are adapted to seasonal changes in disturbance and sand level, unnatural timing or frequency of disturbance may slow recovery rates and reduce the forage base for shorebirds. A change in disturbance frequency also has the potential to affect recovery of subtidal assemblages. Other factors such as sediment compatibility, sedimentation, hydrodynamics, timing relative to recruitment periods, and distance between disturbed and undisturbed areas may influence invertebrate recovery rates (Reilly and Bellis 1983; Rackosinski, et al. 1996; Newell, et al. 1998; Petersen, et al. 2002; Versar 2004). Sediment compatibility also may influence shorebird foraging by indirectly affecting the invertebrate forage base or by interfering with prey capture (Greene 2002; Peterson, et al. 2002).

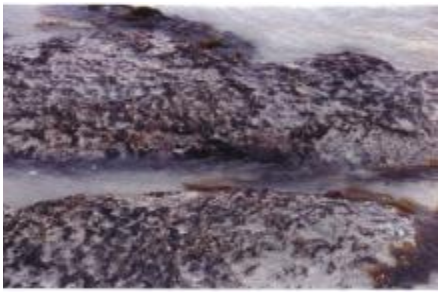
Sandy beach habitat may be enhanced by beach nourishment in erosive beach areas (Melvin, et al. 2001, CZR 2003, SAIC 2006). Sand is the limiting factor associated with seasonal development of the invertebrate community and functional use of the beach for spawning by grunion and foraging, resting, or nesting by shorebirds. Beach nourishment may enhance habitat suitability or functions in erosive beach areas.

Sand management considerations for sandy beach or subtidal habitats include:

- Compatibility between source sands and native sands;
- Timing of onshore activities relative to invertebrate recruitment periods;
- Proximity to critical habitat, nesting areas, or winter concentrations of snowy plovers;
- Frequency of disturbance;
- Potential for modification to hydrodynamics or physical habitat conditions;
- Potential for cumulative impacts associated with change in disturbance frequency; and
- Occurrence of unique resource areas (e.g., Pismo clam beds).

Reefs and Offshore Rocks

Rocky habitats are localized in southern California. Habitat values and functions may vary considerably among hard bottom areas depending on physical characteristics and degree of sand influence. Reef height and complexity are primary factors associated with habitat quality (Ambrose, et al. 1989). Nearshore and intertidal reefs are subject to sand influence within the littoral zone from natural seasonal on- and offshore sand migration. Low-lying reefs subject to sand scour support few biota. Similarly, cobbles subject to sand scour and tumbling from wave action support few biota.



Close-up view of sand-scoured intertidal reef
Photograph by Karen Green, SAIC

In contrast, reefs that extend above the height of seasonal sand movement generally support diverse communities of invertebrates, fish, and vegetation, including commercially important plants (e.g., giant kelp) and animals (e.g., lobster, sea urchins, sea cucumbers, and reef-associated fish). Hard bottom areas also attract recreational sport diving, fishing, and educational interest. Coastal birds may forage on invertebrates or fish associated with rocky intertidal habitats. Intertidal rocky areas also may provide important resting areas for pinnipeds (sea lions, seals). Vegetated hard-bottom habitats of particular concern include surfgrass beds in intertidal and shallow subtidal waters and kelp forests in deeper nearshore waters (see subsections below).

Nearshore reef off Encinitas
Photograph by Danny Heilprin, SAIC

Sand management impact considerations for rocky reefs/offshore rocks include:

- Potential for substantial turbidity or sedimentation based on sand volume and proximity of sand management activities;
- Reef heights and habitat quality; and
- Existing uses (e.g., commercial or recreational fishing, diving, education areas).

Surfgrass Beds

Surfgrass grows on rocky habitats from low intertidal to subtidal depths. Two species occur off the coast of California, *Phyllospadix. scouleri* with short flowering stems and *P. torreyi* with long flowering stems. Although surfgrass may range to depths of 50 feet, beds become patchy and gradually disappear below 23 feet (Williams 1995). Although surfgrass is a flowering plant that produces seeds, development of surfgrass beds is largely by vegetative propagation of the rhizomatous root system. Because this is a slow process, reestablishment of surfgrass beds may take years if the rhizome mat is removed or dies.

Great egrets foraging on surfgrass habitat
Photograph by: Karen Green, SAIC

Surfgrass beds are ecologically sensitive, supporting a variety of habitat functions including foraging habitat for fish and birds, sheltering habitat for fish, and nursery habitat for several species including the commercially important California spiny lobster (*Panuliris interruptus*).

Surfgrass is adapted to seasonal sand movement in shallow water and is considered a sand tolerant species (Littler, et al. 1983). Surfgrass also is considered a beach builder, stabilizing beaches by binding sands with its rhizomatous roots (Gibbs 1902). However, excessive sedimentation that results in prolonged or substantial burial of leaves reduces photosynthesis and growth and may lead to habitat degradation or loss (Reed, et al. 2003).

Although surfgrass may recover relatively quickly from small-scale disturbance by vegetative expansion, recovery can take years if there is substantial disruption or loss of the rhizome mat. Artificial reestablishment of surfgrass beds using seeding or transplants is technically feasible, but has not been demonstrated beyond an experimental scale. Therefore, the effectiveness of compensatory mitigation to restore habitat loss is unknown. These uncertainties, as well as the potential for impacts to have long-term consequences, are primary constraints for sand management projects when surfgrass habitat occurs nearby.

Sand management impact considerations for surfgrass include:

- Potential for substantial sedimentation based on sand volume and proximity of sand management activities;
- Reef heights on which surfgrass occurs; and
- Potential for equipment damage from pipelines or vehicles.

Underwater view of kelp forest
Photograph credit: San Diego Nearshore Program
http://nearshore.ucsd.edu/

Kelp Forests/Beds

Giant kelp forests, with their extensive vertical structure, represent the most diverse of the marine habitats and support commercial fisheries, education, and recreation. Kelp forests/beds are dynamic, with substantial variability in extent of surface canopy between years associated with storms and other oceanographic conditions (e.g., El Niño Southern Oscillation). Although many functional values are tied to the presence of kelp canopy, habitat values persist in the absence of canopy (e.g., understory and bottom-dwelling algae, invertebrates, and cryptic fish species). Therefore, constraints maps in this document are based on historic occurrence and substrate.

Kelp plants are vulnerable to vessel impacts (propellers, anchoring) resulting in frond entanglement or dislodgement of holdfasts. Kelp forest and associated understory vegetation also are sensitive to changing light levels and are limited when light transmission is substantially impaired. Light reduction does not have an impact on adult plants with surface canopies, but can reduce establishment of early life stages and growth of juvenile plants. Therefore, turbidity from sand management is of potential concern if substantial or prolonged.

Kelp forests are highly vulnerable to sedimentation impacts, which can potentially damage plants from abrasion and scour or preclude recruitment when sediment accumulates on hard substrate. Kelp forests primarily occur outside the littoral zone, but may experience sedimentation during high wave conditions (e.g., storms, El Niño). Inshore boundaries of kelp forests, which may extend to shallower waters during mild oceanographic conditions, are most vulnerable to sedimentation and dislodgement during storms.

Understory kelp occurring inshore of kelp forests are adapted to the relatively harsh environmental conditions in the littoral zone, including sedimentation. However, inshore kelp requires hard substrate for attachment; therefore, persistent sedimentation may lead to habitat degradation or loss. Long-term impacts would not be expected from transient sedimentation given the opportunistic life histories of many inshore kelp species.

Sediment management impact considerations for kelp forests/beds include:

- Potential for substantial sedimentation based on sand volume and proximity of kelp forests/beds;
- Potential for prolonged turbidity over kelp bed areas; and
- Potential for equipment damage from vessels and anchoring.

Close-up view of eelgrass
Photograph by SAIC

Eelgrass Meadows

Eelgrass is a marine vascular plant consisting of subsurface rhizomes and above ground leaves. Eelgrass forms submerged beds, also termed meadows, in protected waters. Eelgrass

primarily occurs in bays and lagoons in San Diego County, although a persistent meadow also occurs at Zuniga Point near the entrance of San Diego Bay. Although eelgrass may ranges from low intertidal to depths up to 100 feet, light limitation generally results in shallow depth distributions. Similar to surfgrass, eelgrass primarily expands by vegetative propagation of the rhizomatous subsurface mat (Phillips 1984, NOAA 2001b). Eelgrass is a special aquatic site (SAS) (i.e., vegetated shallows) under Section 404(b) (1) of the federal Clean Water Act.

In southern California, eelgrass may grow year round, although beds exhibit some die back (bed thinning) in winter with reduced leaf density and slowed growth (Ware 1993, MEC 2000b). Eelgrass meadows are used as spawning or nursery areas for many commercially and recreational important finfish and shellfish species, including California halibut, California spiny lobster, sand bass, and surfperch (Hoffman 1986, Ware 1993). Eelgrass meadows also are used as nursery areas for small forage fish (anchovies, silversides), which are preyed upon by the endangered California least tern.

Eelgrass leaves generally are shorter in the intertidal and longer at subtidal depths, ranging from several inches to > 3 feet in southern California (Phillips 1984, Ware 1993). Long, buoyant leaves facilitate photosynthesis under naturally varying light conditions. During periods of active growth, carbohydrate reserves are stored in leaves, rhizomes, and roots that may be used to support metabolism during periods of light limitation (Zimmerman, et al. 1995; Burke, et al. 1996).

Eelgrass beds are slow to recover from sand disruption rhizomes removal, and seed bank removal. Limited seed dispersal can affect natural recovery rates, and colonization by vegetative reproduction is very slow (Orth, et al. 1994, 2006). Recovery may be faster if plant loss affects above ground leaves, but does not affect the rhizomes or the seed bank. Eelgrass habitat loss requires replacement consistent with the Southern California Eelgrass Mitigation Policy (www.http://swr.nmfs.noaa.gov/hcd/policies/EEPO). Sediment management impact considerations for eelgrass include:

- Potential for substantial sedimentation based on sand volume and proximity of eelgrass meadows;
- Potential for prolonged turbidity; and
- Potential for equipment damage from dredges, pipelines, and vessels.

Coastal Dune or Strand

In California, native coastal strand vegetation is designated as rare. Coastal dune or strand habitat has been substantially modified from development, human use, and historical practices involving use of invasive exotic species to stabilize dunes. Beaches with high public use, or limited sand supply and erosive conditions, often lack coastal strand vegetation on the backshore or adjacent coastal dunes. Consequently, functional coastal strand backshore or dune habitat only occurs in localized areas.

Limited coastal strand near Batiquitos
Photograph by Karen Green, SAIC

Coastal dune or strand vegetation are adapted to withstand the stress associated with winds, shifting sands, salt spray, and poor water-holding capacity and low fertility of the sandy sediment. Vegetation generally has low stature, deep or rhizomatous roots, and dense growth patterns that help anchor and protect individual plants from shifting sands and winds (CNPS 1996). However, coastal dune or strand habitat is highly vulnerable to human impacts both from foot traffic and vehicle use.

Coastal dune/strand habitat may support several endangered, threatened, and other rare plant species (CalFlora 2006). Threatened western snowy plover and endangered California least tern may nest in foredune habitat (CCC 1987, USACE 2003).

Sand management impact considerations for coastal dune/strand habitats include:

- Potential for damage or removal of native vegetation by equipment or human disturbance; and
- Potential to interfere with foraging or reproductive functions of sensitive wildlife that may use this habitat.

California Grunion

Grunion spawning
Photograph by Doug Martin

Grunion is a pelagic, schooling fish that generally dwells off sandy beaches from just seaward of the surf line to a depth of approximately 60 feet. Grunion feed on small planktonic organisms and are prey to predators such as larger fishes, California least tern, and marine mammals (Love 1996, Gregory 2001, Martin 2006). Grunion eggs are preyed upon by shorebirds, various invertebrates (worms, insects), and ground squirrels (Martin 2006). Grunion are an endemic species with a very limited habitat range. Sandy beaches are essential fish habitat for this unique California species. San Diego County comprises roughly a third of the entire spawning habitat area for this fish in California (Martin, K., personal communication)

Between late February and early March, California grunion spawn on beaches in southern California; however, spawning may extend through early September (Fritzsche, et al. 1985; Martin 2006). Grunion may spawn on any or all of the 4 to 5 nights following full and new moons (e.g., spring tides), beginning a little after high tide (Gregory 2001, Martin 2006). CDFG makes available each year the predicted grunion runs from March through August. A recreational fishery for grunion occurs during spawning runs during March and June-August; the fishing season is closed in April and May.

During spawning, grunion swim as far up the beach as possible on the breaking wave. These fish spawn above the mean high tide line but below the highest high tide line; beaches that are inundated at an extreme high tide may still support grunion runs as the tide ebbs, either later that night or on subsequent nights. However, narrow beaches that are inundated by high tides across

the spring high tide series associated with predicted multi-day grunion runs would not support successful egg incubation if spawning did occur.

The female excavates the semi-fluid sand with her tail and buries herself up to her pectoral fins. Males mate by curving around a female and releasing their milt as she deposits her eggs. Sand from receding waves covers the eggs to a depth of 6 to 8 inches over the next several days (Smyder and Martin 2002); although burial depths up to 18 inches have been reported (Fritzsche, et al. 1985). Eggs incubate in the sand about 10 days until the spring tides reach them, but incubation may extend an additional four weeks if necessary (Martin 1999, Griem and Martin 2000, Smyder and Martin 2002). Mechanical agitation by wave action triggers hatching (Griem and Martin 2000).

Habitat suitability for spawning may vary seasonally in association with natural erosion and accretion cycles. On erosive beaches, habitat suitability may span fewer months than the grunion spawning season. Beach nourishment was found to extend habitat suitability across the spawning season at several sites in Encinitas after RBSP I (SAIC 2006). Thus, beach nourishment may actually benefit California grunion by creating or expanding sandy beach spawning habitat.

Primary concerns regarding impacts to grunion are that beach nourishment will disturb, bury, or otherwise adversely affect spawning success. Turbidity also has the potential to affect adult fish during sand management activities, due to these planktivorous fish aggregating for spawning and feeding in the nearshore.

Substrate compatibility is an important consideration for habitat suitability. Fine sediments can block interstitial spaces in the sand and prevent adequate oxygenation of eggs (Martin and Swiderski 2001). However, critical impact thresholds with respect to substrate characteristics are unknown. Beach slope also may be important. Steep slopes or scarps may inhibit spawning or limit egg survival. Narrow beach width or slopes that are too flat could result in egg wash out or saturation. The effects of increased fine sediment on nearshore spawning aggregations and feeding for these planktivorous fishes are unknown.

Sediment management impact considerations for California grunion include:

- Schedule of activities relative to spawning season (March 1-August 31);
- Habitat suitability for spawning;
- Compatibility of placed sands and fill design (e.g., slope) with habitat suitability;
- Sand placement and equipment operation in spawning habitat;
- Monitoring for occurrence of grunion spawning activity up to two weeks prior and during sand placement; and
- Potential to enhance suitability of spawning habitat.

Snowy Plover

Western Snowy Plover
Photograph by Callie Bowdish

Western snowy plover is a federal threatened species and California Species of Special Concern. Critical Habitat has been designated at several beaches in San Diego County (Table 5, Figures 14-21). The USFWS also has identified locations where habitat may be suitable to support wintering concentrations (wintering areas), although information on actual use is limited. Potential wintering areas shown on Figures 14-21 are from the 2007 Recovery Plan for the Pacific Coast Population of the Western Snowy Plover. It also is possible that other locations than shown in the 2007 Recovery Plan may be used for wintering, such as Buena Vista Lagoon and Torrey Pines State Beach – Blacks; prior nesting also has occurred on South Carlsbad State Beach and other areas of the Silver Strand than shown on Figure 20 (USFWS, 2009 personal communication). The breeding season for western snowy plovers extends from early March to late September.

Snowy plovers nest on sparsely vegetated sands at beaches, creek and river mouths, created dredge spoil islands, flats of salt evaporation ponds, and salt pannes in lagoons and estuaries (Miller, et al. 1999). Nests are depressions in the substrate lined with bits of debris or shells and may be scattered throughout an area rather than in defined colonies. Human use of nesting beaches has been the greatest factor in the decline of the western snowy plover (Bruce, et al. 1994).

Snowy plovers feed on sand crabs, sand hoppers, flies, beetles, brine shrimp, and other aquatic and terrestrial invertebrates. On beaches, snowy plovers probe for crustaceans and worms in the low-tide zone, search for insects and other small invertebrates among debris (especially drift kelp) along the high-tide line, or probe the sand under low foredune vegetation (Lafferty 2000).

Snowy plovers have cryptic coloration and tend to crouch in depressions, which makes them very hard to notice unless they move. This increases their vulnerability to being run over by vehicles or being trampled (Lafferty 2000). These birds are relatively tolerant of humans at distances greater than 100 feet (Lafferty 2000, 2001).

Sand management projects may require consultation with the USFWS and USACE under Section 7 of the ESA if activities would occur in or adjacent to critical habitat, during the breeding season, or in areas of wintering concentrations. Sand management impact considerations for western snowy plover include:

- Schedule of activities relative to the breeding season (March 1-September 30);
- Proximity to nesting areas;
- Potential for disturbance near nesting areas or in areas where there are wintering concentrations of birds;
- Compatibility of placed sands in areas adjacent to critical habitat and wintering areas; and
- Potential to enhance wintering and critical habitat locations.

California Least Tern

California least tern is a state and federal listed endangered species. Least terns breed in colonies on sparsely vegetated sandy beaches, flats of salt evaporation ponds, created dredge spoil islands, and non-beach sandy surfaces in coastal areas (Figures 14-21). California least terns are only present in California during the breeding season of April through September (Atwood, et al. 1994).

California Least Tern
Photograph by Kathy Keane

Least terns feed on small surface schooling fishes such as topsmelt, northern anchovy, jacksmelt and mosquitofish. They are opportunistic in their foraging behavior and may shift locations in response to localized concentrations of suitable prey (Atwood and Minsky 1983). They forage in the ocean from just beyond the surf line to up to 1 to 2 miles out to sea (Collins, et al. 1979), although they have been documented to forage up to five miles from the nesting colony (USFWS 2000). The majority of least tern foraging is within 1 mile of shore in waters less than 60 feet deep (Atwood and Minsky 1983, AMEC 2002). During the breeding season, California least terns depend on an adequate supply of small fishes near their breeding colonies. When the adults forage away from their nests, young are left unprotected and vulnerable to predation.

Sand management projects may require consultation with the USFWS and USACE under Section 7 of the ESA, particularly if activities would be within 1 mile of nesting colonies during the breeding season. RGP 67 restricts activities within 3,000 feet of breeding colonies. Because least tern nesting areas occur at several locations along the coast of San Diego County, the USFWS should be contacted to determine if consultation would be necessary for any sand management project proposed during the tern breeding season (USFWS, 2009 personal communication). Sand management impact considerations for California least tern include:

- Schedule of activities relative to the breeding season (April 1-September 30);
- Proximity to breeding colonies; and
- Potential for turbidity from sediment management activities interfering with foraging activities near breeding colonies.

5.0

SEDIMENT SOURCES

Information on sediment suitability and existing/future sediment sources for restoration projects within the San Diego Coastal RSM Plan area is presented within this section. Although some information regarding these sources is known, information regarding material properties, timeframe of their availability and transport costs vary and are still being determined. Important characteristics of sediment source types are provided in Table 6. These sources vary in quantity, and the frequency of which they become available are shown in Table 7, which is not necessarily comprehensive. It shows basic sources but could be expanded, and sediment quality is unknown as well.

Table 6: Existing Sediment Sources

Property	Upland Soil	Flood Control Basin/Corridor	Lagoon	Bays/Harbors	Offshore Ocean
Grain Size	Narrow range, but more fines near surface (25%+)	Broad range, rocks to silts, also debris	Narrow range, mainly fine to medium sand	Moderate range, sandy to silty	Narrowest range, medium sand
Chemistry	Potential contaminants in top 5 feet	Potential contaminants throughout	Typically clean	Clean to contaminated	Clean
Quantity	Very small to Small, (<25,000 to 100,000 cy)	Very small (<25,000 cy); Dams can be significant (500,000 cy)	Small-Moderate * (25,000's to 500,000 cy)	Moderate to large* (100,000's to millions cy)	Largest (>1,000,000 cy)
Typical Availability	Annually or semi-annually	Annually to bi-annually	Annually to every 3 years	Annually to every 5 or more years	Every 5 to 10 years or more

*Restoration or development may generate very large volumes

SOURCE DESIGNATION	LOCATION	Source Name	QUANTITY (Cubic Yards)	Distance to Coast (Miles)	OWNERSHIP	DATE AVAILABLE	CONTACT	PHONE
North County Coastal								
NC-CP-SMR	Oceanside	Camp Pendleton - Santa Margarita River	--	2-5	U.S. Marine Corps	Unknown	Viola Innis	(760) 725-7245
NC-CP-NS	Oceanside	Camp Pendleton - Nearshore		0	State Lands Commission	Unknown	Ken Foster (SLC)	(916) 574-2555
NC-CP-DMBB	Oceanside	Camp Pendleton - Del Mar Boat Basin	2,500	<1	U.S. Marine Corps	September 2008	Robert Grove (SCE)	(626) 302-9735
NC-OS-H	Oceanside	Oceanside Harbor	201,000 CY/YR historic bypass rate	<1	City of Oceanside	Annually	Don Hadley (Oceanside)	(760) 435-4000
NC-OS-SML	Oceanside	Santa Margarita Lagoon	Unknown	<1	City of Oceanside	Unknown	Don Hadley (Oceanside)	(760) 435-4000
NC-OS-LAC	Oceanside	Loma Alta Creek Maintenance	Unknown	1	City of Oceanside	Unknown	Don Hadley (Oceanside)	(760) 435-4000
NC-OS-ELC	Oceanside	El Corazon Project	Unknown	2	Private Developer	Unknown	Don Hadley (Oceanside)	(760) 435-4000
NC-OS1	Oceanside	Oceanside Beach Resort	Unknown	<1	Private Developer	Unknown	Don Hadley (Oceanside)	(760) 435-4000
NC-CB1	Carlsbad	Poinsettia Train St/Multi-Use	30,000 - 40,000	1	Private Developer	Unknown	Steve Jantz (Carlsbad)	(760) 602-2738
NC-BVL	Carlsbad	Buena Vista Lagoon Restoration	300,000 – 600,000	1-3	City of Carlsbad/Oceanside	2008-2009	Jerry Hittleman (Oceanside)	(760) 435-3520
NC-CB2	Carlsbad	City Detention Basins	<12,000		City of Carlsbad	Unknown	Steve Jantz (Carlsbad)	(760) 602-2738
NC-CB-AHL	Carlsbad	Agua Hedionda Lagoon	300,000	<1	City of Carlsbad	Bi-annually	Steve Jantz (Carlsbad)	(760) 602-2738
NC-CB-EC	Carlsbad	Encinas Creek Maintenance	Unknown	<1	City of Carlsbad	Unknown	Steve Jantz (Carlsbad)	(760) 602-2738
NC-CB-AHC	Carlsbad	Aqua Hedionda Creek Maintenance	Unknown	5	City of Carlsbad	Unknown	Steve Jantz (Carlsbad)	(760) 602-2738
NC-CB-BL	Carlsbad	Batiquitos Lagoon	83,000 Flood bar qty in 4 yrs growth	1-5	California Department of Fish and Game	Every 5 yrs	Tim Dillingham	(858)467-4204
NC-CB1	Carlsbad	Hotel Development	Unknown	<1	Private Developer	Unknown	Steve Jantz (Carlsbad)	(760) 602-2738
NC-CB2	Carlsbad	Condo Development	Unknown	<1	Private Developer	Unknown	Steve Jantz (Carlsbad)	(760) 602-2738
NC-ENC1	Encinitas	Saxony Detention Basin Maintenance	10,000	2	City of Encinitas	Unknown	Kathy Weldon (Encinitas)	(760)633-2632
NC-ENC2	Encinitas	Encinitas Resort Hotel	50,000	<1	Private Developer	Unknown	Kathy Weldon (Encinitas)	(760)633-2632
EN-ENC3	Encinitas	Batiquitos Lagoon Detention Basin	Unknown	2	City of Encinitas	Unknown	Kathy Weldon (Encinitas)	(760)633-2632
NC-ENC4	Encinitas	Pacific Station Project	37,000	<1	Private Developer	November 2008	Kathy Weldon (Encinitas)	(760)633-2632
NC-SEL	Cardiff	San Elijo Lagoon Restoration	800,000	1-3	County of San Diego	Unknown	USACE	(213) 452-3675
NC-SB1	Solana Beach	Mixed-Use / Train Station Project	100,000	1	Private Developer	mid-2006 to 2008	Leslea Meyerhoff (Solana Beach)	(858) 720-2440
NC-SB2	Solana Beach	I-5 Widening	Unknown	3	Caltrans	Unknown	Bruce April	(858) 616-6614
NC-SDL	Del Mar	San Dieguito Lagoon Restoration	78,000	1-5	SoCal Edison Project	2008-2009	Hany Elwany	(858) 459-0008
NC-TPR	North San Diego	Torrey Pines Retention Basin	56 & I-5	<1	CA State Parks	Unknown	Denny Stoffer	(760) 720-6375
NC-LPL	North San Diego	Los Penasquitos Lagoon Restoration	10,000 - 20,000	1-5	Unknown	Unknown	Hany Elwany	(858) 459-0008
NC- I-5	North San Diego	Caltrans I-5 Widening	Unknown	1-3	Caltrans	Unknown	Unknown	
NC-RR	North San Diego	LOSSAN Railroad Widening	Unknown	1-2	North County Transit District	Unknown	Unknown	

Table 7: Typical Quantities and Timing of Existing Sediment Sources

SOURCE DESIGNATION	LOCATION	Source Name	QUANTITY (Cubic Yards)	Distance to Coast (Miles)	OWNERSHIP	DATE AVAILABLE	CONTACT	PHONE
North County Inland								
NI-POW	Poway	Flood Control Channels	20,000 cy/yr		City of Poway	Unknown	Unknown	
NI-NS-1	Bonsal	San Luis Rey River	250,000 - 500,000		To be determined	3-5 years	Kevin Quinn (City San Diego)	
NI-LHR	County of San Diego	Lake Hodges	7,300,000	12 (Oceanside)	Nelson & Sloan	Now	Fred Colin	(760) 744-7130
NI-LSM	San Marcos	Lake San Marcos	Unknown	>10	City of San Diego Water Dist.	Unknown	Rosalva Morales (SDWD)	(619) 527-3119
NI-SM1	San Marcos	San Marcos Sediment Basins	Unknown	>10	City of San Marcos - Public Works	Unknown	Paul Buckley	
NI-LSR	County of San Diego	Lake Sutherland Reservoir	2,600,000	>10	Unknown	Unknown	Unknown	
NI-SLR	County of San Diego	Highway 76 / I-15 Widening	30,000	>10	Suket Construction	Now	Scott Emery	(760) 754-9104
Central County Coastal								
CC-SDB	North Island	Navy Construction Projects	30,000	<1	Navy			
CC-MML	Miramar	Miramar Landfill	Less than 100,000		Navy	Unknown	Ed Kleeman (Coronado)	(619) 522-7329
CC-SDF	County-wide	Flood Control Channels	500,000	10-30	City of San Diego	Unknown	Joseph Corones	(619) 492-5034
CC-MB	City of San Diego	Mission Bay	Unknown	1-2	County of San Diego	Unknown	Marianne Green (City San Diego)	
Central County Inland								
CI-SDC	Ramona/Spring Valley	Flood Control Channels	100,000	>10	County of San Diego	Unknown	Unknown	
CI-ECR	Alpine (near)	El Capitan Dam Maintenance	9,600,000	>10	County Water Authority	Unknown	Sid Tesoro (San Diego (County)	(858) 232-5151
CI-SVR	Blossom Valley	San Vicente Dam Maintenance	3,200,000	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	(619) 527-3119
CI-SLR	Ramona/Julian	Sutherland Dam Maintenance	92,000	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	(619) 527-3119
CI-LLR	County of San Diego	Loveland Lake Reservoir	Unknown	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	(619) 527-3119
CI-LPV	County of San Diego	Lake Palo Verde	Unknown	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	(619) 527-3119
South County Coastal								
S-TJ	Imperial Beach / County of San Diego	Goat Canyon Sediment Basins – Border Field State Park	60,000	1	CA State Parks	2008-2009	Clay Phillips	(619) 575-3613 x303
S-TJ-1	Imperial Beach / County of San Diego	Tijuana River Valley Restoration	500,000	1	CA State Parks	Unknown	Clay Phillips	(619) 575-3613 x303
S-CV	Chula Vista	Detention Basins	Unknown	>10	County of San Diego	Immediately	Unknown	Unknown
S-CVM	Chula Vista	Chula Vista Marina	300,000	5-10	City of Chula Vista	Unknown	Dave Byers (City of Chula Vista)	619-691-5021
S-SP	Chula Vista	South San Diego Salt Pond	Unknown	5-10	City of Chula Vista	Unknown	Unknown	Unknown
S-SR	County of San Diego	Sweetwater Reservoir	Unknown	10-30	County Water Authority	Unknown	Unknown	Unknown
S-SDB	City of San Diego	San Diego Bay	Up to 400,000	5	ACE, Navy, Port of San Diego	Unknown	Unknown	Unknown
S-C1	City of Imperial Beach	Sea Coast Inn	30,000	<1	Private Developer	2008-2009	Unknown	Unknown
S-SDR-1	City of San Diego	San Diego River Mouth	50,000	<1	City of San Diego	Unknown	Unknown	Unknown
Offshore								
SM-1	Offshore	SM-1	~2,000,000 suitable	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555

(cont.)

Table 7: Typical Quantities and Timing of Existing Sediment Sources

(cont.)

SOURCE DESIGNATION	LOCATION	Source Name	QUANTITY (Cubic Yards)	Distance to Coast (Miles)	OWNERSHIP	DATE AVAILABLE	CONTACT	PHONE
Offshore (continued)								
SO-9	Offshore	SO-9	873,000 Unsuitable, very fine sand	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-7	Offshore	SO-7	Depleted after SDRBSP	NA	State of California	NA	Ken Foster (SLC)	(916) 574-2555
SO-6	Offshore	SO-6	688,000 Remaining after SDRBSP	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-5	Offshore	SO-5	5,480,000 Remaining after SDRBSP	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
TP-1	Offshore	TP-1	Mostly fine grain sand / high silt content	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-4	Offshore	SO-4	1,500,000 Fine grain	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
MB-1	Offshore	MB-1	25,737,000 Remaining after SDRBSP	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SS-1	Offshore	SS-1	7,592,000 Unsuitable, very fine w cobbles	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
ZS-1	Offshore	ZS-1	Mostly fine grain sand / high silt content	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SS-1	Offshore	SS-1	~6,000,000 suitable	NA	State of California	Now	Ken Foster (SLC)	(916) 574-2555

Table 7: Typical Quantities and Timing of Existing Sediment Sources

5.1 Locations – Upland, Coastal, and Offshore

Sediment sources range from the local watershed to the region and beyond, as well as at upland, coastal and offshore locations. Currently known potential source locations are briefly described below.

5.1.1
Upland Sources

Sediment sources of interest to this Coastal RSM Plan exist seaward of the coastal watershed drainage divide. These sources generally are more plentiful downstream and closer to the coast and less abundant farther inland, due to topography and greater intensity of development. The SCOUP document (2006) inventories upland sediment sources that include development sites, dry river beds, dry flood control channels, dry sediment detention basins, and roadway widening projects. This CRSM Plan updates that upland sediment source inventory. Sources are diverse, but generally are most numerous within drainage courses such as water-related infrastructure (flood control). Maps of sediment source locations are included as Figures 22 and 23. Upland sand sources are referred to as opportunistic beach fill in this CRSM Plan. Other types of sources also discussed below are categorized separately.

5.1.2
Coastal - Lagoons and Harbors

Six lagoons, one estuary, and three harbors exist within the Coastal RSM Plan region (Figure 24). Lagoons within the region that may provide sand either from maintenance dredging and/or restoration include the following (from north to south):

- Buena Vista Lagoon in Oceanside/Carlsbad;
- Agua Hedionda Lagoon in Carlsbad;
- Batiquitos Lagoon in Carlsbad;
- San Elijo Lagoon in Encinitas/Solana Beach;
- San Dieguito Lagoon in Del Mar;
- Los Penasquitos Lagoon in San Diego; and the
- Tijuana River Estuary south of Imperial Beach.

All of these lagoons have either been historically dredged, or are expected to need dredging for wetland restoration at some point in the future.

The three harbors within the Coastal RSM Plan area are Oceanside Harbor, Mission Bay, and San Diego Bay. Oceanside Harbor is dredged annually, and the sand placed south of the pier along the beaches of Oceanside. The City of San Diego or USACE may plan to dredge Mission Bay in the near future for maintenance, and San Diego Bay is periodically dredged to address ongoing sedimentation. Dredging is currently being planned within San Diego Bay by the USACE in 2009. Sediment dredged from the harbor was disposed of offshore Imperial Beach in past maintenance dredging. Sediment quality is a potential issue with harbor sediments, but testing is required prior to placement, and contaminated sediments are disposed of in an appropriate manner rather than used for beach nourishment.

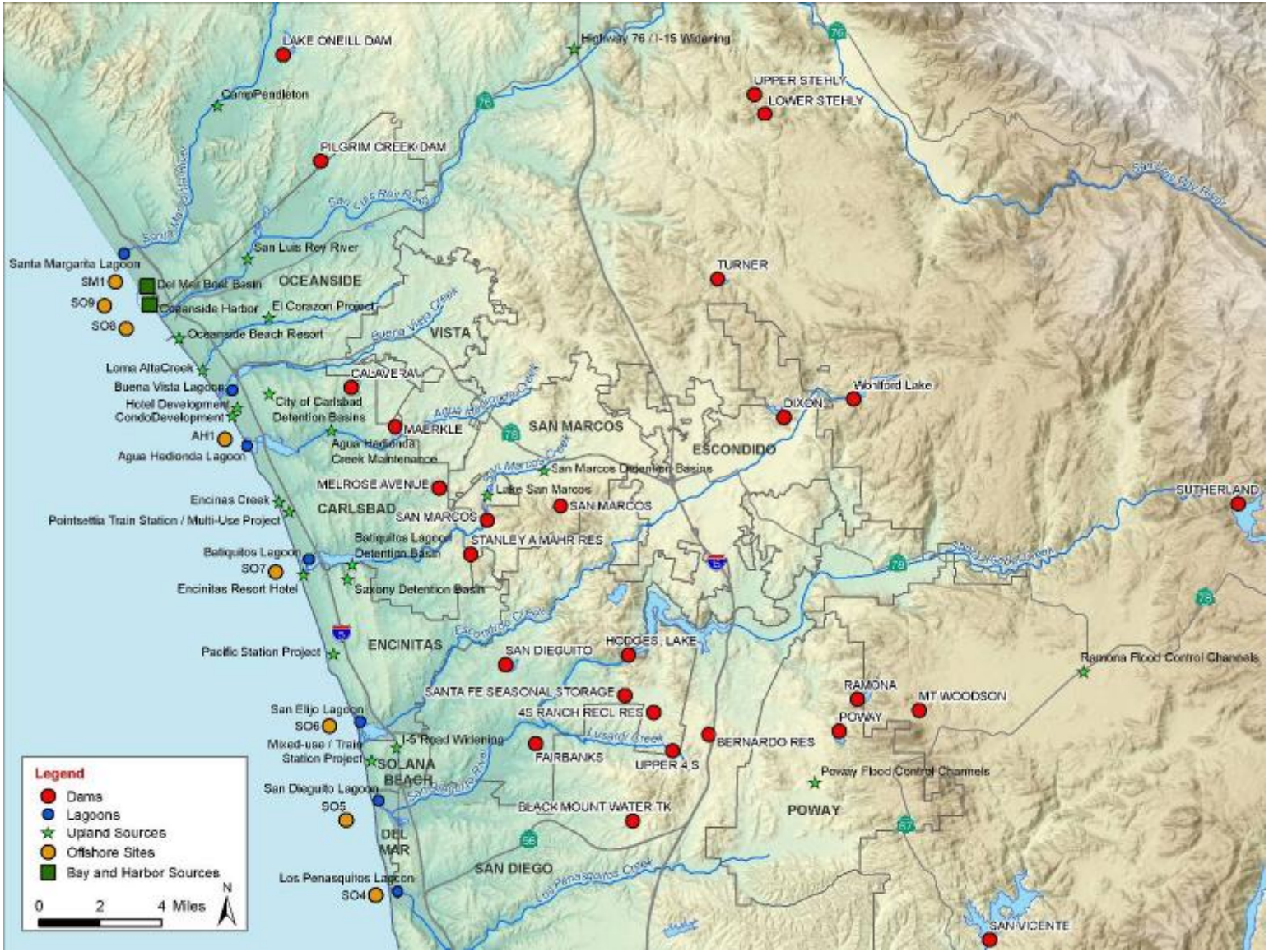


Figure 22 – Sediment Source Locations in the North County Region

Figure 23 – Sediment Source Locations in the South County Region

Figure 24 – Lagoons and Harbors in San Diego County

5.1.3
Offshore Sources

Offshore sediment sources along the entire reach of the Coastal RSM Plan region (Figure 25) were previously identified by SANDAG and used for RBSP I, and a few additional potential borrow sites were identified during development of this Plan. Ten offshore borrow sites were previously investigated as part of RBSP I. These sites are as follows (from north to south):

- SO-9 off Oceanside harbor to the north;
- SO-8 off Oceanside harbor to the west;
- AH-1 off North Carlsbad (near Agua Hedionda Lagoon);
- SO-7 off South Carlsbad (near Batiquitos Lagoon);
- SO-6 off South Encinitas (near San Elijo Lagoon);
- SO-5 off Del Mar (near San Dieguito Lagoon);
- SO-4 off Torrey Pines (near Los Penasquitos Lagoon);
- MB-1 off Mission Beach;
- SS-2 off Imperial Beach north end (also referred to as USACE Area A); and
- SS-1 off the Tijuana River Estuary.

It was determined that SO-4, SO-8, AH-1, and SS-2 (USACE Area A) did not meet grain size criteria. Sites SO-9, SO-7, SO-5, MB-1, and SS-1 were initially used by SANDAG for RBSP I. During construction, SO-9 and SS-1 were eliminated from consideration due to dredging fine grain sizes and cobble, respectively. The highest quality sand source sites used for construction were SO-7, SO-6, and MB-1. The other remaining site at SO-5 was also used, but the sand was considered too fine and it did not remain on the beach for very long after the project.

As part of SANDAG's upcoming RBSP II in 2011 or 2012, some of the same sites and three new sites were investigated. The new sites and locations are as follows:

- SM-1 off the Marine Corps Base (MCB) Camp Pendleton (near the Santa Margarita River) and just north of Oceanside Harbor (both offshore and nearshore);
- TP-1 off south Torrey Pines (near Black's beach); and
- ZS-1 of Coronado (on Zuniga Shoal).

Inclusion of TP-1 as part of RBSP II was a result of data collected from recent offshore investigations by SIO (Hogarth, et al., 2007). This type of study is referred to as offshore neotectonics; it analyzes the effects of current or recent motions and deformations of the Earth's crust. The study used high-resolution geophysical data to conclude that sand has become "ponded" or trapped upcoast of or adjacent to offshore, uplifted bedrock portions of the Rose Canyon Fault Zone. Areas of trapped sand include a site immediately north of the Scripps Canyon and a second site between the Scripps and La Jolla Canyons. These sand deposits are estimated to be nearly 20 meters (66 feet) thick, with the thickest deposits directly north of the Scripps Canyon. Review of the SIO studies suggested the recent sediment mapped within the area between Scripps and La Jolla submarine canyons appeared less extensive than the sediment deposited upcoast of the Scripps Canyon. This site holds promise for future planning and is designated as TP-2. The TP-1 site is located immediately upcoast of the Scripps Submarine

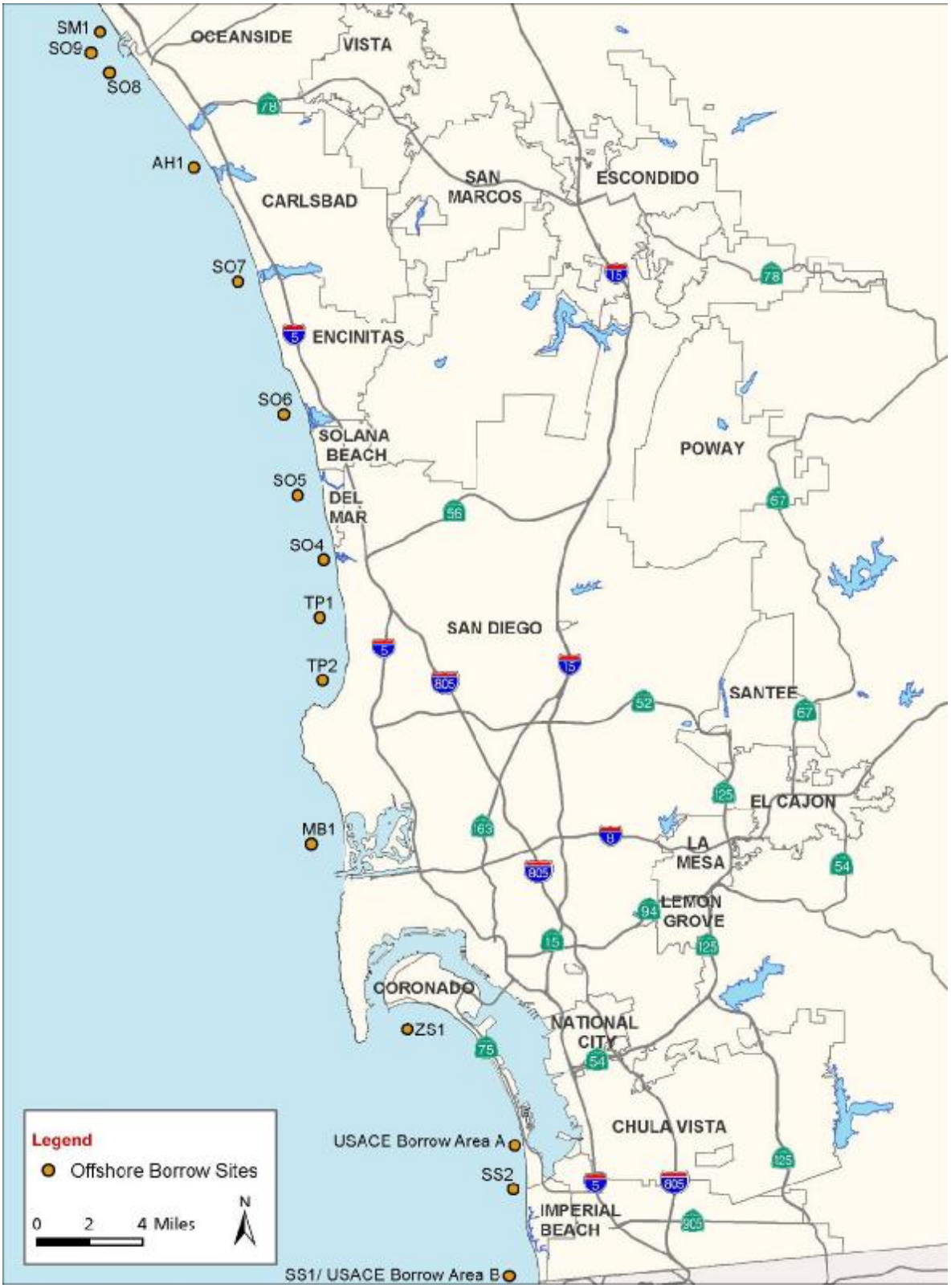


Figure 25 – Offshore Sediment Sources in San Diego County

Canyon deposit where sand has accumulated along a six kilometer stretch of shore-parallel, uplifted bedrock resulting in a relatively thick lens of sand referred to as a "sand belt."

SANDAG investigated many of the offshore potential sand deposits in 2008 as part of RBSP II. They used high resolution, multi-channel seismic technology along the entire region as a first step to identify candidate sites (Fugro 2008). This was followed by vibracoring at specific locations to retrieve, examine, and analyze physical samples (Alpine 2008). These recent sand investigations have yielded preliminary results of sand quality and quantity at the new sites, and at some of the previous sites as well. Sand quality as related to whether the deposits at those locations could be appropriate for beach restoration was assessed as:

- SM-1 is suitable to good;
- SO-7 yields no more sand;
- SO-6 is good to excellent;
- SO-5 is excellent (the investigation moved farther inshore than the area dredged in 2001);
- TP-1 is marginal;
- MB-1 is excellent;
- ZS-1 is poor; and
- SS-1 is suitable to good.

5.2 Quantities

Approximate sediment quantities for upland, lagoon, and harbor and offshore sources are discussed in this section, listed by source in Table 7, pages 64-66**.**

5.2.1 Upland Quantities

Source sediment quantities vary broadly, and generally are less than 50,000 cubic yards of material. Many are between 5,000 and 10,000 cubic yards due to limited volumes of the sediment storage basins. Larger quantities are less common, but can reach up to 100,000 cubic yards for urban development projects. Flood control basin sources are typically less than 25,000 cubic yards.

Exceptions to the trend of smaller quantities of available upland sand are reservoirs behind dams that can yield millions of cubic yards. In North County, Lake Henshaw on the San Luis Rey River holds up to 6 million cubic yards of sand, and Lake Hodges on the San Dieguito River now holds 3 million cubic yards of sand. Five dams on the San Diego River hold 3.6 million cubic yards of sand total, and three dams on the Tijuana River hold 2.4 million cubic yards of sand (Slagel 2006).

Road widening projects, such as I-5 widening by Caltrans, can also generate larger quantities of material. I-5 was widened from Sorrento Valley in San Diego through Del Mar for a distance of several miles. Caltrans plans on widening I-5 farther north through Encinitas and Carlsbad, so additional material will be available in the future. Finally, improvement projects at rivers, such as the San Luis Rey River in Oceanside, yield material. As an example, one project is occurring

near the I-15/SR76 interchange in 2008 that is yielding 30,000 cubic yards of material presently being marketed by the contractor.

5.2.2
Lagoon and Harbor Quantities

Lagoon sediment quantities are generally small to moderate with a range of 25,000 to 500,000 cubic yards. Harbor sediment quantities are generally moderate to large with a range of 100,000 cubic yards to millions of cubic yards.

5.2.3
Offshore Quantities

Offshore sediment source quantities are the largest and can be greater than 1,000,000 cubic yards. However, offshore sources are limited by dredging capabilities and by proximity to receiving beaches. Operating water depths for hopper dredges are typically between 20 and 80 feet. However, modifications can extend dredge depths down to 90 feet. Dredging at depths greater than 90 feet would require specialized equipment and may not be cost-effective.

5.3 Qualities

Sediment quality is defined by both the percentage of fines (silt and clay) in the material and its chemical properties. Chemicals tend to adhere to fine-grained sediments such as silts and clays due to the relatively large surface area of a particle and the tendency of these particles to attract chemicals with opposite charges. Sand grains possess smaller surface areas compared to silts and clays, contain less of a charge, and chemical molecules are therefore less able to adhere to their surface. Therefore, sediment with relatively high proportions of silts and clays presents a greater probability of the presence of contaminants compared to sediments with lower proportions of fine-grained particles. Potential sources are always tested for chemistry and never used for beach placement if chemical pollution is detected.

5.3.1
Upland Sediment Quality

Upland sediment quality varies widely with chemically clean sediment found in the deeper sandy geologic layers. Contaminants present in sediments tend to be in the shallower deposits because they are applied at the surface from past land uses (farming, gasoline stations, etc.). The likelihood of contaminants being present is greatly influenced by historical and present land uses. Potential contaminants include pesticides, oils and grease, bacteria, PCBs, hydrocarbons, plastics, and other chemicals. The SCOUP document (2006) also discusses upland sediment quality in detail.

Potential sources behind dams, within debris/catchment basins and other flood control structures, beneath construction projects, etc. can vary widely in grain size. Sediment from behind dams can have a high percentage of fines, and that captured by debris basins may contain cobbles, sands

and fines, thereby requiring sorting prior to use for nourishment. Dependant on location and associated geology, sediment from construction projects may contain relatively homogenous sands or a heterogeneous mixture of grain sizes.

Upland sediment including sand, gravel, crushed stone, slag, or recycled crushed concrete, also can be used as sources for construction aggregate. Efforts are underway by SANDAG to study regional challenges to meeting aggregate supply and demand issues. It is not likely that all construction aggregate from upland sources will be compatible with regional beaches. However, when material could be compatible with both uses, SANDAG will consider the benefits and costs associated with the use of the material and endeavor to match specific sediment sources with specific sediment needs. As the aggregate study moves forward, SANDAG will inform the members of the SPWG so relevant information supporting the objectives of the Coastal RSM Plan and the regional aggregate strategies can be coordinated.

5.3.2
Lagoon and Harbor Quality

Lagoon and harbor sediment sources typically have relatively high percentages of fines and can contain chemical constituents of concern, varying by region and watershed. Lagoons within the Coastal RSM Plan area lie at the base of generally urban watersheds. Runoff from these urban areas can contain chemical contaminants, which can then be retained within the lagoon's finer-grained sediments. Sediment distribution within lagoons varies, dependent on the lagoon's tidal dynamics and storm flow hydraulics, which are generally contingent on the lagoons inlet configuration and the stability of its inlet channel. Lagoons with greater tidal flows develop flood shoals that contain relatively lower percentages of fines since these deposits are formed from beach sand. Lagoons with muted tidal flows will generally contain higher percentages of fines due to the source of their sediment being more of a mix from both the ocean and upland watershed.

Sediment quality in harbor channels typically has medium percentages of fines due to these channels being subject to tidal flows. However, these areas, particularly back-harbor areas, have an increased potential of chemical contaminants due to marine vessel borne pollutants. For example, heavy metals, such as copper, can be found in sediments in these areas from anti-fouling paints that are applied to boat hulls.

5.3.3
Offshore Ocean Quality

The grain size distribution of offshore sand sources varies spatially, but is largely sand with some silt overburden. Layers with different grain sizes are not uncommon. Due to their high sand content, these sources are generally clean chemically. Grain size distribution offshore is contingent upon the locations of existing and paleo-river outlets, natural and manmade hardbottom features (reefs), the regional longshore and cross-shore current climate, and structural traps resulting from geologic processes.

5.4 Ownership

5.4.1
Upland Ownership

Ownership of upland sources is typically a private entity or local government, with the latter or a state agency having discretionary authority over the development of the site. The California Department of Parks and Recreation owns and administers a significant portion of coastal territory within the boundaries of the Coastal RSM Plan. Lands along the coast are within the jurisdiction of the CCC unless there is an approved Local Coastal Plan in place for the specific location. Upland state land ownership invokes stewardship responsibilities for natural and cultural resources, as well as recreation and enjoyment by the public. Some state-owned properties are managed by local governments, but state ownership persists and state policies and sensibilities are still to be applied.

5.4.2
Lagoon and Harbor Ownership

The state of California typically owns areas below the mean high tide line at lagoons. The submerged land is administered by the CSLC, with active site management by either the State Parks Department or the DFG. Various local agencies generally own areas above the mean high tide line at lagoons, with certain exceptions. Harbor ownership varies and can be the local city, port authority, USACE, Navy, or local jurisdiction.

5.4.3
Offshore Ocean Ownership

The state of California owns all offshore submerged lands out to three miles offshore, and the CSLC administers those lands. These lands are included within the jurisdiction of the SLC and CCC for regulation via permit authority. These state agencies generally manage land within the Coastal RSM Plan region seaward of the mean high tide line.

5.5 Timeframe of Material Availability

Upland sands tend to be available on an on-going basis as development and maintenance actions occur throughout the region. The availability of specific sources depends on the project status and can vary from immediately to the five year future or longer.

Lagoon and harbor sand is typically available each year that maintenance dredging occurs. Harbor source availability is contingent upon maintenance schedules of the particular harbor. Lagoon restoration projects occur less often, and material is available on a longer-term schedule, such as every five to ten years or longer for substantial projects. The last two substantial projects were Batiquitos Lagoon restoration in 1995 and San Dieguito Lagoon restoration in 2007. Three

other major lagoon restoration projects are in planning including Buena Vista Lagoon, San Elijo Lagoon, and the Tijuana River Estuary.

Offshore ocean sand sources are readily available with no timing restrictions other than those imposed at the receiver sites. Restrictions that may dictate the frequency of offshore dredging are mainly economics and weather seasons (spring and summer being the calmest periods). Offshore sources may be limited in their availability and could potentially be "mined out" in the future if sufficient dredging were to occur over time. Sufficient quantities are estimated to exist offshore to meet the 30 million cubic yard estimate from the SPS (1993).

5.6 Contact Person and Information

Contact information for sand sources (Table 7, pages 64-66) includes the contact person and phone number for identified sediment sources. Some of these people have provided information about their respective sources during public workshops hosted by SANDAG for the Coastal RSM Plan. This is not an exhaustive list and new sources should be provided to SANDAG as they become known and available. SANDAG staff also are available to work with interested parties to further research regional sediment sources.

5.7 GIS Data Layers

Geographic Information System (GIS) data layers of sand sources from upland areas, lagoons, harbors, and offshore areas were developed in support of the Coastal RSM Plan effort. An inventory of these layers was provided to SANDAG and the CSMW as a separate submittal. Several GIS layers from the CSMWs GIS database were provided and used during Plan preparation.

6.0

SEDIMENT MANAGEMENT APPROACH FOR VARIOUS CATEGORIES OF SEDIMENT SOURCES

This section presents specific considerations and recommendations for regional sediment management using a variety of probable sediment sources. Each type of source - upland, lagoons and harbors, and offshore - lends itself to a different management approach in terms of transport methods, receiver site(s), quantities, and placement design. Possible management approaches for each sediment source type are described below.

Various types of sand placement sites are referred to in this section of the Plan. For clarity, definitions of the range of sand placement sites are:

Onshore – Sand placed on the dry beach, as a berm, between the elevations of 0 and +12 feet MLLW and sand placed in the high-tide surf zone by earthmoving equipment from the dry beach onshore. Sand placed onshore as a beach berm is typically "optimum" sand. The high-tide surf zone is accessible at lower tides, but becomes inundated at higher tides. Surf zone placement is useful for less-than-optimum sands due to the winnowing effect of waves and currents and broad dispersal of fine-grained particles.

Nearshore – Sand placed on the seabed in water depths between -5 and -30 feet MLLW. Nearshore placement is suitable for any type of sediment, except that the USEPA prohibits placement of sediment with greater than 50% fines. Nearshore placement provides for flexibility in nourishment activities if placement volumes are greater than can be accommodated onshore due to environmental constraints, or if the sediment quality is less-than-optimum.

6.1 Upland Sediment

Materials from upland areas generally possess a different quality than material from an aquatic environment. As described in the SCOUP program (Moffatt & Nichol 2006), upland materials may include a range of sediment characteristics from optimum sands with a relatively low percentage of fines (0 to 15 percent) to less-than-optimum sands with a relatively high percentage of fines (between 15 and 45 percent). Materials from reservoirs, rivers, or debris basins may be poorly sorted, containing a broad range and mix of grain sizes. In contrast, materials from dry (e.g., geologic deposits) upland areas can be more homogeneous in gradation due to soil-forming processes or historic depositional stratigraphy. However, upland materials (dry upland areas and water bodies/courses) may possess a higher portion of less-than-optimum sands than materials from streambeds, lagoons, harbors, and the ocean. This is due to the higher energy conditions of active waterways that tend to winnow fine-grained particles out of depositional areas.

6.1.1
Availability and Timing

Dry upland material is nearly constantly available due to ongoing development and maintenance projects, and site-specific sources tend to out-number wet upland sources. Dry upland sources are typically smaller in quantity than wet upland sources, but can have a larger areal extent and may be more available in the dry season.

The timing of opportunistic beach fill projects has thus far emphasized placement in the fall, winter, and early spring seasons. Summer placement has been discouraged, although limited summer placement is acceptable in some instances. Timing is intended to avoid sensitive bird nesting and breeding seasons, and potential impacts to habitat and recreation from increased turbidity. Similar environmental windows are likely to be required for different types of fill, with the exception of ocean sediment (containing fewer fines), which can be placed in the nearshore during summer if monitoring occurs to verify low turbidity levels and lack of impacts.

6.1.2
Transportation

Upland material is typically transported by truck to the discharge site. Other modes of transport are possible, including train, conveyor belt, or hydraulic pipeline (from lakes) through suitable terrain. However, innovative measures such as sluicing material from reservoirs through river valleys are not commonly considered as feasible due to logistical and practical difficulties, such as permitting restrictions for working in sensitive riparian habitats. Rail car transport is feasible, and some of the proposed Coastal RSM Plan sites possess attributes for future rail delivery, such as proximity to the rail line, but most receiver sites do not presently possess a rail access point. It may be possible to retrofit certain receiver sites with infrastructure to receive material by rail. These are not yet called out in this report, as further studies are needed to identify suitable sites in light of the future double-tracking plans by the North County Transit District. Therefore, for this Coastal RSM Plan, most or all opportunistic sand is assumed to be trucked to the beach.

6.1.3
Receiver Sites

Beach receiver sites suitable for upland material all require surf zone placement sites. Surf zone placement sites are considered to be onshore placement. Sites are designated as potential receivers of upland beach fill material if they are readily accessible from a major transportation route, have easy access to the beach, and in some instances are located relatively far from residential land uses to minimize disturbances and potential issues with public safety and truck circulation.

Logistics

San Diego County is characterized by several regional transportation routes that are parallel to the coast, providing north to south access (e.g., I-5 and Highway 101) that are principal routes to the potential upland receiver sites. Also, several major east-to-west access routes extend from inland to the coast (Highways 905 to Imperial Beach, I-8 to Ocean Beach, 52 to La Jolla, 56 to Torrey Pines, and 76 and 78 to Oceanside). Several smaller east-to-west access corridors between these larger ones provide supplemental access to the coast from inland.

Receiver sites for upland sand should be positioned near the location of regional east-to-west access routes to benefit from inland material. A number of receiver sites have been identified as appropriate specifically for opportunistic sand. These sites also possess the attributes considered in the SCOUP report (Moffatt & Nichol 2006) such as needing sand, being relatively distant from residential land uses, possessing construction access ramps, and other criteria considered in that document. If possible, receiver sites for upland sand should also be in the vicinity of stockpile areas that provide for screening, processing, storage, and optional handling of the material. Otherwise, it is assumed that the material is processed prior to delivery to the coast at the source location.

§ North and Central County

Logistics associated with potential upland beach fill projects for North San Diego County are briefly described herein. They are based on existing and proposed opportunistic beach fill programs at Oceanside, Carlsbad, Encinitas, and Solana Beach.

Regional transport routes relative to beach locations are shown in Figure 26 and also listed below.

- Highways 76 and 78 in the north;
- Via De La Valle, Palomar Airport Road, La Costa Avenue, and Manchester Drive in central North County; and
- Highways 56 and 58 as options in the southern North County.

Potential upland receiver sites, transport routes to those locations, and access considerations include:

- South Oceanside, from Highways 76 and 78 (an existing rail spur exists near Oceanside Boulevard for the future option of rail delivery, two truck ramps exist, and a stockpile site is identified at El Corazon);
- South Carlsbad State Beach (north), from Palomar Airport Road (the site needs a temporary ramp as is planned by the City for each project, and no stockpile site is available);
- Batiquitos Beach in Encinitas, from La Costa Avenue (the site possesses existing at-grade access, but no stockpile site is available; however it is in proximity to Saxony Detention Basin, identified by Encinitas as a stockpile site);
- Moonlight Beach, from Encinitas Boulevard (the site possesses existing at-grade access, and a stockpile site exists at Saxony Detention basin);

Figure 26 – Regional Transport Routes in San Diego County

- Cardiff State Beach, from Manchester Avenue (the site needs a ramp and possesses no stockpile site);
- Fletcher Cove, from Via De La Valle (the site possesses an existing ramp but no stockpile site); and
- Torrey Pines State Beach, from Highways 56 and 52 (the site needs a ramp and possesses no stockpile site).

North and Central County receiver sites are shown in more detail in Figures 27 and 28. Using existing and proposed opportunistic beach fill programs as guidelines (and to be consistent with the approach used to formulate these programs), each site is designated to receive a maximum quantity of 150,000 cubic yards of material annually, except for the Batiquitos Beach in Encinitas site which is limited to 120,000 cy/yr due to the sensitivity of being adjacent to Batiquitos Lagoon.

§ South Central and South County

Potential upland beach fill project logistics for South Central and South San Diego County are mainly based on proposed programs at Coronado and Imperial Beach with Ocean Beach as an additional site. Specific transport routes are:

- Interstate 8;
- Highway 70 (Coronado Bridge);
- Palm Avenue (Main Street in Imperial Beach);
- Imperial Beach Boulevard;
- Highway 905; and
- Monument Road.

Potential upland receiver sites, transport routes to those locations and access considerations include:

- Ocean Beach in San Diego, from Interstate 8 (a new concrete ramp exists but may require protection of some type, and a stockpile site exists at the adjacent Dog Beach);
- Coronado Beach, from Highway 70, local streets, and the North Island Naval Air Station (at-grade beach access exists, but no stockpile sites are available);
- Imperial Beach, from Palm Avenue, Imperial Beach Boulevard, and Highway 905 (two truck ramps exist, but no stockpile sites are available); and
- Border Field State Park beach, from Monument Road and from Tijuana Estuary debris basins (at-grade access exists over state property but is constrained by a small bridge that needs to be temporarily spanned for truck deliveries).

South Central and South County receiver sites are shown in more detail in Figures 29 and 30. Coronado is designated to receive a maximum quantity of 100,000 cubic yards of material annually, and Imperial Beach and the Border Field State Park beach are limited to 75,000 cubic yards per year each, due to the sensitivity of being adjacent to the Tijuana Estuary. These quantity limits are taken from proposed opportunistic beach fill programs at Coronado and Imperial Beach, respectively.

Figure 27 – North County Upland Sediment Receiver Sites

Figure 28 – Central County Upland Sediment Receiver Sites

Figure 29 – South Central County Upland Sediment Receiver Sites

Figure 30 – South County Upland Sediment Receiver Sites

6.1.4
Habitat Considerations

Placement of optimum sediments onshore generally is not constrained from the perspective of sand compatibility. However, frequency or timing of placement and volume and duration of projects are important considerations for minimizing potential adverse effects to sensitive biota and habitats including:

- Sandy beach invertebrates;
- California grunion;
- California least tern;
- Western snowy plover; and
- Nearshore reefs and kelp beds.

Construction activities have the potential to adversely impact the invertebrate community from burial or spreading of fill material with earth-moving equipment. Invertebrates seasonally recruit to beaches and have a peak productivity period in spring and summer, and lower abundance during fall and winter, associated with offshore sand migration. Sand placement during the low season minimizes interference with natural seasonal recruitment and development of the sandy beach invertebrate community, which provides forage base for fishes and shorebirds.

If construction activities are considered during the period of grunion runs, then beaches should be assessed for habitat suitability, and if suitable, monitored prior to and during placement activities to ensure that grunion eggs are not damaged or buried during construction. Monitoring should take place even if no grunion are expected to arrive as beaches change over the course of a season. However, monitoring would not be necessary if habitat is not suitable for spawning (e.g., insufficient beach width, rocky, shallow sand depths).

When opportunistic placements are conducted more than once a year, avoidance of repetitive placement of sand in the same location is recommended to speed invertebrate recovery rates. Successive placements should be separated by a protective distance interval (e.g., 150 feet) and not require vehicle disturbance of previous placement locations (e.g., placement started farthest from the beach access location and successive placements made closer to the access location) (Moffatt & Nichol 2006).

Generally, sediment placement during September 30 through February 28 minimizes potential effects to the biota and avoids sensitive use periods of protected species such as California grunion, California least tern, and western snowy plover. One exception concerns wintering concentrations of snowy plover. Although several potential wintering areas have been identified in San Diego County (USFWS unpublished data), available winter survey data indicates that actual use differs among sites and years. Pre-project coordination with resource and regulatory agencies is mandatory for receiver sites located within identified snowy plover wintering areas. Coordination should include review of recent winter survey data, as available, and identification of whether additional mitigation measures (e.g., construction monitoring) may be warranted.

For projects occurring between March 1 and September 30, pre-construction survey assessment or coordination with resource and regulatory agencies will be necessary consistent with RGP 67 (USACE 2006) and the SCOUP (Moffatt & Nichol 2006) to ensure no adverse impacts to sensitive resources.

- During the California grunion spawning season (March 1-August 31), habitat suitability to support spawning success must be assessed. If suitable, construction monitoring will be required to ensure no adverse impacts to the species. Grunion monitoring during construction may be waived if habitat is unsuitable (e.g., extensive cobble cover, insufficient sand thickness, narrow beach width with substantial wave exposure across tides).
- If a receiver site is located within 1,500 feet (500 yards) of snowy plover nesting areas, sand placement would be restricted during the breeding season (March 1 through September 30) unless otherwise coordinated in advance with the USFWS and USACE.
- If a receiver site is located within 3,000 feet (1,000 yards) of a California least tern breeding colony, sand placement would be restricted during the breeding season (April 1 through August 30) unless otherwise coordinated in advance with the USFWS and USACE.

Discharge of less-than optimum sands should be confined to less-sensitive areas due to turbidity and sedimentation concerns. Discharge near the mouths of active streams during the winter season would most closely approximate natural conditions. Discharge near sensitive reef and vegetated habitats or near nesting sites of California least tern during the breeding season is not recommended. Frequency, volume, and discharge rate should be controlled to minimize the potential for adverse or cumulative impacts to beach and nearshore hard or soft-bottom communities. Initial projects should involve small volumes (e.g., < 25,000 cubic yards). Sediment testing before and after discharge is recommended to verify that beach and nearshore sand characteristics in the vicinity of the receiver site are not significantly altered by placement of less-than optimum sand. Volume and frequency may be adaptively refined in subsequent placements based on monitoring results.

A study is being conducted at the Tijuana Estuary to document the fate and transport of upland sediment containing up to 49 percent fines. Approximately 44,000 cubic yards total of material is planned for delivery to the beach by truck from a nearby debris basin, and approximately 24,000 cubic yards of the material was placed in at the beach in 2008. The USGS monitored the turbidity and pattern of sedimentation in 2008, and may monitor future phases. The remaining material may be placed in 2009. The objective is to provide information for possible reconsideration of the 80/20 (sand/fines) rule-of-thumb presently employed by the USEPA and USACE for project approvals. Results of monitoring are still pending. If the study results indicate that sediment with more than 20% fines can be used for beach nourishment without significant adverse effects, then the viability of upland sand sources (as well as wetland restoration) for improving the region's sand deficit may be enhanced. However, as of the writing of this Plan, completion of the project has been put on hold.

6.1.5
Placement Designs and Restrictions

Upland sand placement options are described fully in the SCOUP document (Moffatt & Nichol 2006) and in the technical and environmental documentation for each local agency's opportunistic beach fill program under the SCOUP process (EDAW 2006 and 2008; Moffatt & Nichol 2000c). Carlsbad possesses a separate opportunistic beach fill program from the SCOUP programs. Cities participating in the SCOUP programs are:

- SCOUP I
  - Oceanside.
- SCOUP II
  - Encinitas;
  - Solana Beach;
  - Coronado; and
  - Imperial Beach.

Placement options are defined in the first portion of Section 6.0. Options consist of onshore placement as a berm on the high, dry beach if the material is optimum sand. Alternatively, the material could be placed at the surf-line in a low-tide dike or mound if the material is less-than-optimum sand. Nearshore placement is less desirable because it requires hydraulic pumping, which results in the need for additional material handling and higher costs.

Material placement is restricted over time and space to reduce trucking impacts, and to minimize environmental impacts. Delivery of all materials by truck is controlled to reduce the number of truck trips on roadways to an acceptable level within each City (Moffatt & Nichol 2000c, EDAW 2006 and 2008). Less-than-optimum sands are placed at the beach at a specified rate over time to minimize turbidity and potential impacts to invertebrates.

6.1.6
Stockpiling

Regional or subregional stockpile sites could increase the flexibility of opportunistic beach fill operations. Flexibility is needed to provide temporary staging if the following conditions occur:

- Suppliers cannot fund transport to the coast;
- The materials need to be processed prior to delivery to the coast; and/or
- The quantity exceeds the allowable placement volume, and it would need to be placed either at a later date or at a different location.

Project economics tend to be more favorable for delivering material to the coast if the source is relatively close to receiver sites or the quantities of material to be transported are large. Sources may be far enough from the coast to render transport economically infeasible. In addition, quantities from specific projects may be so small as to render the project incapable of funding

transport to the coast. In these instances, stockpile sites could serve as "deposit" locations for suppliers intending to contribute their material to a future opportunistic beach fill project.

Any material placed at a designated regional or local stockpile must be chemically clean before arrival and preferably already processed (screened of boulders/rocks, debris, trash, vegetation, and any other material incompatible with beach fill). The stockpile site may be a suitable location to perform processing operations if sufficient space is available.

Two stockpile sites are currently designated as part of proposed opportunistic beach fill programs in San Diego County - the El Corazon site in Oceanside and Saxony Detention Basin in Encinitas. These sites would supplement sediment management activities at multiple opportunistic beach fill receiver sites at South Oceanside (El Corazon), and Batiquitos Beach and Moonlight Beach (Saxony Basin). Other stockpile sites should be considered for use in sediment management activities elsewhere in the County. Candidate stockpile sites should be on public land if possible to avoid the cost of leasing the land from private landowners. Figure 31 shows example stockpile locations within the region, which includes:

- Undeveloped lots in Otay Mesa;
- Vacant lots near the intersection of Seaworld Drive and Friars Road in San Diego;
- Miramar landfill;
- The Highway 56 corridor; and
- The Tijuana Estuary stockpile site.

Figure 31- Examples of Potential Stockpile Locations

Theoretically, stockpiled material could be managed by account so that contributors could be credited for their contribution and potentially given some form of offset or incentive to make the donation attractive. Multiple sources of materials at a given stockpile site should be kept physically separate and somehow labeled with signage or markings to identify the source and donor. All stockpile areas would have to conform to Water Board requirements for storm water and erosion control. Costs to truck the stockpiled material to the coast could periodically be funded by the state or others.

6.2 Lagoon Restoration, and Lagoon and Harbor Maintenance

Sediment deposits in lagoons and harbors require periodic or regular removal. Examples are described below.

- **Maintenance Dredging Material**

  Harbors and coastal lagoons open to the ocean are repositories for sand transported in by overwash and flood-tide currents. Streams and rivers do not appreciably contribute sediment to downstream areas (the coast, harbors and lagoons) in this region due to damming for flood control and water conservation. Consequently, sand delivered to harbors or open lagoons from the coast is lost to the littoral zone until it is either flushed or mechanically moved to the beach and/or nearshore. The term used herein for sediment management from these sources is maintenance dredging, and it is a critical component of the coastal sediment budget.

  Littoral sand that collects in lagoons and harbors generally is well-sorted and of fairly uniform grain size. The sediment usually possesses a higher percentage of sand and lower percentage of fines than upland sand. This material generally represents optimum sand for renourishment. The median grain size diameter may be relatively fine. Therefore, sediment removed from restored lagoons and existing harbors close to the active littoral zone is typically of high quality for beach nourishment. The higher energy level of the littoral environment, even if protected, leads to deposition of the relatively larger and heavier sediment such as sand (compared to fine-grained silts and clays). As such, this material tends to be clean of contaminants because they do not adhere as well to sand grains as they do to silts and clays. This conclusion applies to the outer harbor areas where sand from the ocean has deposited. Inner harbors that receive siltation from surrounding upland areas may possess a higher percentage of fine-grained sediment, and the sediment may be contaminated.

- **Wetland Restoration Material**

  Sediment that deposits in protected and low energy aquatic environments, such as closed (or not yet restored) lagoons, represents new sediment that can be added to the littoral zone to offset losses to the region. Sediment from wetland restoration projects will be relatively poorly-sorted. The quieter conditions of a closed lagoon lead to a depositional environment for all sizes of sediments, including sand from periodic coastal influxes and fines from the upland watershed. This material represents a mix of optimum and less-than-optimum sand in stratigraphic layers. Therefore, sediment removed from a lagoon

during restoration may consist of alternating layers of sandy sediment and finer sediments. This material can therefore potentially possess contaminants in the finer-grained layers contributed from the watershed.

6.2.1
Availability and Timing

§ **Maintenance Dredging Material**

Maintenance-dredged material is typically available on a recurring basis such as annually or bi-annually. These sources and their respective actual and projected quantities are shown in Table 8. The quantities vary, but total up to approximately 700,000 cubic yards for the region. They are more predictable in amount and frequency than other sources because they are delivered by a fairly constant process of wave- and tidal-driven currents. Maintenance dredging is typically done in the fall or spring to avoid the high beach use season and winter storms, respectively.

Table 8 – Estimated Annual Quantities of Sediment from Maintenance Dredging/Excavation

Location	**Annual Quantity (Cubic Yards)**	**Activity**
1. Oceanside Harbor	222,000	Harbor maintenance dredging
2. Del Mar Boat Basin	2,500	Dredging of boat launch ramp at inner Oceanside Harbor for larger vessel access
3. Agua Hedionda Lagoon	300,000	Lagoon maintenance dredging
4. Batiquitos Lagoon	25,000	Lagoon maintenance dredging
5. San Elijo Lagoon	25,900	Lagoon mouth opening
6. San Dieguito Lagoon	16,000	Projected lagoon mouth maintenance (not opened yet as of this writing)
7. Mission Bay entrance channel	Undetermined, but estimated to be relatively small (10,000 assumed)	Possible future channel maintenance dredging
8. Lower San Diego River (mouth area in Ocean Beach)	Undetermined, but estimated to be relatively small (10,000 assumed)	Possible lower river flood control maintenance or habitat restoration of Famosa Slough
9. San Diego Bay	100,000 (estimated)	Harbor maintenance dredging
TOTAL	**701,400**	Not applicable

Sources: Coastal Frontiers Corporation (2007) for 1, 3 and 5; Southern California Edison for 2 and 6; State Department of Fish & Game for 4; Moffatt & Nichol for 7, 8, and 9.

§ **Wetland Restoration Material**

Material from lagoon restoration is available on an infrequent basis (decade or longer periods). Sand volumes vary widely, from 60,000 cubic yards (to be removed from the San Dieguito Lagoon mouth as the last restoration stage) to 1.5 million cubic yards dredged from Batiquitos Lagoon for restoration in 1995 (Table 9). They are less predictable in volume and frequency than maintenance dredging projects. Restoration work is typically done in the fall and winter to avoid affecting sensitive nesting birds in spring and summer.

Table 9 - Periodic Quantities of Sediment FromWetland Restoration Activities

Location	Periodic Quantity (Cubic Yards)	Activities
1. Buena Vista Lagoon	800,000	Future lagoon restoration
2. Batiquitos Lagoon	1,500,000	Lagoon restoration in 1995
3. San Elijo Lagoon	500,000	Future lagoon restoration
4. San Dieguito Lagoon	60,000	Future channel restoration
5. Los Peñasquitos Lagoon	Quantity undetermined	Future lagoon restoration
6. San Diego Bay	Quantity undetermined	Future restoration
7. Tijuana Estuary	600,000	Future restoration
TOTAL	**3,160,000**	

Sources: Everest International Consultants for 1; Moffatt & Nichol for 2; San Elijo Lagoon Conservancy for 3; Southern California Edison for 4; Nordby Biological for 7. No estimates are yet available for items 5 and 6.

6.2.2 Transportation

Material generated in an aqueous environment is dredged and discharged by slurry line because it is already in water. Compared to truck trips, this mode of transport is unobtrusive and has less of an impact on the surrounding environment. It is an efficient and inexpensive way to convey sediment, while being relative unnoticeable.

6.2.3 Receiver Sites with Proportional Placement

An important consideration regarding placement of dredged material from maintenance and restoration activities is the placement location along the coast within the littoral zone. Presently, most projects place material as close to the dredge site as possible to minimize costs. The placement location relative to the deposition location is typically “downcoast” or wherever there is a demonstrated need. However, some projects actually place the material “upcoast” relative to the dredge site for various reasons including political ones, and at times because of a misunderstanding of the net longshore transport direction.

An objective of coastal regional sediment management should be to retain sand within the littoral zone for as long a time period as possible before it is potentially lost to the littoral cell. Therefore, more study of sand transport direction is needed in the vicinity of each inlet/entrance channel to identify site-specific littoral transport patterns. Net longshore sediment transport in the North County San Diego region is generally to the south at a rate of between 100,000 to 250,000 cubic yards per year (with significant variation) (USACE 1991). Sediment placement from many projects anticipates southward transport and results in the majority of placement occurring downcoast, south of the maintenance or restoration location.

However, studies for the City of Encinitas show that longshore transport direction in the vicinity of the San Elijo Lagoon mouth are northward up to 80% of the time in summer, and 40% of the time in winter, with the average being 45% north and 55% south over the year (Coastal Environments 2001). As such, sand placement from restoration at that lagoon could be done proportional to the net transport direction at the time of construction. This approach mainly applies to North County San Diego, as the South County area possesses only one lagoon entrance (Tijuana Estuary) toward the southern end of the littoral cell.

Another consideration should be the existence of lagoon-subcells identified by SIO researchers (O'Reilly 2008). As described in Section 3.0 of this Plan, work by O'Reilly indicates that North County San Diego is broken up into a series of lagoon subcells along the coast where longshore sediment transport is interrupted and deflected offshore at the lagoon locations. Sand placement near lagoons should be done considering implications of these observations on ultimate sand losses to the offshore zone from the littoral zone. Initial indications are that sediment dredged from lagoons should be placed downcoast approximately one-half mile or more from the lagoon to remain outside of the influence of these theoretical lagoon subcells.

This Coastal RSM Plan recommends placing material so as to maximize its lifespan within the active littoral zone. Based on available information, this plan generally recommends placing less than half of the sand from lagoons upcoast and more than half of it downcoast to minimize return to lagoons or harbors. Also, providing as much distance as possible between the placement sites and source lagoons or harbors will reduce return flows. Figures 32 through 36 show the San Diego County maintenance dredging operations. Proportional sand placement scenarios are offered in Table 10 as Coastal RSM Plan maintenance dredging receiver sites to optimize coastal regional sediment management. Several new nearshore sites are included to increase flexibility in operations and to reduce potential cumulative impacts of several projects occurring simultaneously. Existing or historical operations performed consistent with these recommendations are noted in Table 10 as "existing" or "historical," and new recommendations are noted as "new."

Table 10 - Proportional Placement of Sediment from Local Dredge Projects

Dredge Location	Annual Quantity (Cubic Yards)	Placement Location
Maintenance Dredging/Excavation Projects		
Oceanside Harbor	222,000	Onshore 100% south of Tyson St (existing); alternatively Oceanside nearshore for less than optimum sand (new)
Del Mar Boat Basin	2,500	Onshore 100% at South Oceanside (new)
Agua Hedionda Lagoon	300,000	Onshore 60% south of entrance, 40% north of entrance (new)
Batiquitos Lagoon	25,000	Onshore with 60% south of entrance, 40% north of entrance (new); alternatively nearshore for less than optimum sand (new)
San Elijo Lagoon	25,900	Onshore 100% south of entrance (existing); alternatively nearshore for less than optimum sand (new)
San Dieguito Lagoon	16,000	Onshore 60% south of entrance, 40% north of entrance (new)
Mission Bay entrance channel	Undetermined, but estimated to be relatively small (10,000 assumed)	Onshore 100% north of entrance (historical)
Lower San Diego River (mouth area in Ocean Beach)	Undetermined, but estimated to be relatively small (10,000 assumed)	Onshore 100% south of entrance (new)
San Diego Bay	100,000	Onshore 100% south of entrance at Coronado and Imperial Beach (historical); alternatively nearshore at either Coronado or Imperial Beach for less than optimum sand (new)
Future Wetlands Restoration Dredging Projects – Placement Location recommendations are all new		
Buena Vista Lagoon	800,000	North Carlsbad onshore for optimum sand; Oceanside nearshore for less than optimum sand
San Elijo Lagoon	800,000	Onshore 45% north of entrance, 55% south of entrance; Cardiff nearshore for less than optimum sand
San Dieguito Lagoon	60,000	Onshore 60% south of entrance, 40% north of entrance; Del Mar nearshore for less than optimum sand
Los Peñasquitos Lagoon	Quantity undetermined	Onshore 60% south of entrance, 40% north of entrance; Torrey Pines nearshore for less than optimum sand
Tijuana Estuary (Phase 1 Project, per Chris Nordby 2008)	600,000	Onshore 60% north of entrance at Imperial Beach, 40% south of the Estuary mouth; and nearshore Imperial Beach for less than optimum sand

Figure 32 – Maintenance Dredging and Wetland Restoration (North County)

Figure 33 – Maintenance Dredging and Wetland Restoratin (North Central County)

Figure 34 – Maintenance Dredging and Wetland Restoration (Central County)

Figure 35 – Maintenance Dredging and Wetland Restoration (South Central County)

Figure 36 – Maintenance Dredging and Wetland Restoration (South County)

Several new receiver sites are identified for lagoon and harbor maintenance dredging that are located in the nearshore zone off the beach. These new nearshore receiver sites are off the following beach areas:

- South Oceanside;
- Batiquitos Lagoon;
- Cardiff State Beach;
- San Dieguito;
- Torrey Pines State Beach;
- Mission Beach;
- Coronado; and
- Imperial Beach (two sites, each located on opposite sides of the pier).

6.2.4
Habitat Considerations

Excessive sedimentation reduces habitat quality within lagoon and harbor habitats and is controlled with periodic maintenance dredging or excavation. Habitat restoration may be required when sedimentation alters tidal exchange and/or substantially degrades habitat functions. Proportional placement may minimize impacts to biota by decreasing the frequency of sediment management activities. A decrease in sedimentation rates within lagoons has the potential to reduce the frequency of maintenance dredging. Similarly, a reduction in dredge frequency has the potential to reduce the frequency of placement of suitable dredged materials on beach sites adjacent to lagoons. Habitat considerations associated with onshore placement of optimum and less-than-optimum sands are described in Section 6.1.

Nearshore receiver sites are located over sandy subtidal habitats relatively close to lagoons and harbors to increase flexibility of beneficial reuse of suitable source materials from maintenance dredging. The inclusion of nearshore sites also may improve lagoon maintenance schedules by providing nearby sites to receive less than optimum sediments. Sediment grain size characteristics of less than optimum sediments are within the range of grain sizes on the lower beach profile and can be used for nourishment. These sediments are required to be free of contamination to ensure compatibility with beneficial use objectives. Similar to onshore placement, primary impact considerations with use of nearshore sites include sediment compatibility and recovery rates of benthic invertebrates, avoidance of sensitive hard bottom and vegetated habitat areas, and minimizing adverse turbidity and sedimentation effects on sensitive habitats and biota.

Because receiver sites must be located relatively close to be a cost-effective for use during lagoon restoration or lagoon and harbor maintenance, an important habitat consideration is the potential for sediment migration after placement to alter sedimentation rates, inlet shoaling, and/or frequency of maintenance requirements and disturbance of sensitive estuarine habitat and biota. Consequently, location and distance of receiver sites relative to prevailing current direction as well as placement volumes are important factors related to habitat considerations.

Limited information is available regarding locations of soft-bottom sensitive aquatic resource areas. Potential occurrence of Pismo clam beds and effects on essential fish habitat would require assessment. Pre-project surveys to document existing conditions, and coordination with commercial fishermen to better understand local uses of the area, may be necessary to minimize potential adverse effects and to reduce conflicts with use of nearshore sites. While locations of hard bottom nearshore habitats are relatively well known in the region, less information is available on habitat quality. Field assessment of habitat quality of hard-bottom areas, if present in the vicinity, may be necessary to finalize the design and/or to support environmental review and permitting of some nearshore sites.

6.2.5
Receiver Sites Without Proportional Placement

The existing sediment placement scenario as part of maintenance dredging operations is referred to as being non-proportional to the net longshore sediment transport rate. Existing dredging operations do not necessarily place sand in the locations where it will move downcoast away from the inlet/entrance channel. This sediment placement practice is the default scenario that can continue to be used if proportional placement poses unforeseen complications, such as costs, to the sediment discharger. Existing sand placement is shown in Table 11 with proposed nearshore placement sites (labeled "new") to provide flexibility for lagoon and harbor maintenance.

Table 11 – Non-Proportional Placement of Sediment from Local Dredge Projects

Dredge Location	Annual Quantity (Cubic Yards)	Placement Location
Maintenance Dredging/Excavation Projects		
Oceanside Harbor	222,000	Onshore 100% south of Tyson St (existing); alternatively Oceanside nearshore for less than optimum sand (new)
Del Mar Boat Basin	2,500	Onshore 100% at South Oceanside (new)
Agua Hedionda Lagoon	300,000	Onshore 40% south of entrance, 60% north of entrance
Batiquitos Lagoon	25,000	Onshore with 50% south of entrance, 50% north of entrance; alternatively nearshore for less than optimum sand (new)
San Elijo Lagoon	25,900	Onshore 100% south of entrance; alternatively nearshore for less than optimum sand (new)

(cont.)

Dredge Location	**Annual Quantity (Cubic Yards)**	**Placement Location**
Mission Bay entrance channel	Undetermined, but estimated to be relatively small (> 10,000)	Onshore 100% north of entrance
Lower San Diego River (mouth area in Ocean Beach)	Undetermined, but estimated to be relatively small (> 10,000)	Onshore 100% south of entrance
San Diego Bay	100,000	Onshore 100% south of entrance at Imperial Beach; alternatively nearshore at either Coronado or Imperial Beach for less than optimum sand (new)
Tijuana Estuary/Goat Canyon Debris Basins	50,000	In surfzone 100% north of site
Future Wetlands Restoration Dredging Projects		
Buena Vista Lagoon	800,000	North Carlsbad onshore for optimum sand (new); Oceanside nearshore for less than optimum sand (new)
San Elijo Lagoon	800,000	Onshore 45% north of entrance, 55% south of entrance; Cardiff nearshore for less than optimum sand (new)
San Dieguito Lagoon	60,000	Onshore 60% south of entrance, 40% north of entrance; Del Mar nearshore for less than optimum sand (new)
Los Peñasquitos Lagoon	Quantity undetermined	Onshore 60% south of entrance, 40% north of entrance; Torrey Pines nearshore for less than optimum sand (new)
Tijuana Estuary (Phase 1)	600,000	Onshore 60% north of entrance (Imperial Beach - new), 40% south of entrance (new); and nearshore Imperial Beach for less than optimum sand (new)

6.2.6
Habitat Considerations

Environmental effects associated with non-proportional placement would be similar to existing sediment management activities. However, the inclusion of nearshore sites may improve lagoon maintenance schedules by increasing flexibility for beneficial reuse of maintenance materials. Habitat considerations associated with placement of optimum and less-than-optimum sediments were described in Sections 6.1 and 6.2.4.

6.2.7
Placement Designs

The main types of material placement consist of:

- Onshore if it is optimum sand from maintenance dredging or restoration;
- Nearshore if it is less-than-optimum sand anticipated from wetland restoration and with large enough quantities to make it cost-effective (100,000 cubic yards or more); and
- Surf-zone dike if the material is less-than-optimum sand and the volumes are too small to make nearshore placement cost effective.

Each placement mode is described in greater detail in the SCOUP report (Moffatt & Nichol 2006). Onshore placement is used to create a level beach berm created over the high and dry area of the existing beach that then slopes seaward at a certain point toward the water. It can also include surf zone placement along the low water line using earthmoving equipment to create a low dike or mound that is subsequently reworked and redistributed naturally by tides and waves. Nearshore placement is deposition in depths of approximately between 5 and 30 feet of water in a mound by hydraulic means.

6.3 Offshore Sediment

Sediment deposits in the offshore and outside of the active littoral cell can consist of relic depositional layers of drowned river valleys or cross-shore losses that occurred during severe storms. This material has been lost from the littoral cell and will remain sequestered unless it is removed and replaced within the littoral zone. These deposits represent a potentially large supply of new sediment from outside the littoral cell available for nourishment.

The term used herein for sediment management from these sources is dredging from offshore. It has become a critical component of the coastal sediment budget for the San Diego region since SANDAG utilized this type of material for RBSP I (Sea Surveyor 1999; Noble Consultants 2000). SANDAG plans to use offshore sands as the primary source for their RBSP II in 2011 or 2012. Research of sand deposits offshore of San Diego County has continued since RBSP I by various groups, and additional potential sources have been identified (Coastal Conservancy and SANDAG 2008; Hogarth, et al. 2007). SANDAG conducted new offshore investigations in late 2008. The USACE plans to use the same or similar offshore sources as SANDAG for any projects they may conduct in North and South County as well.

Littoral sand that deposits in the relatively quiet areas farther from shore can be well-sorted and has a fairly uniform grain size. The material tends to deposit in stratigraphic layers that vary in properties, but large sand lenses are typically present at or near the surface of the seafloor. Existing data indicate that offshore sediment deposits possess a higher percentage of sand and lower percentage of fines than upland sand (Alpine 2008). This material represents optimum sands and is of high quality for beach nourishment. It varies from being relatively fine in median grain size (at site TP-1 offshore of Torrey Pines State Beach) to being fairly coarse (at site MB-1 off Mission Beach). Additionally, the sandy layers tend to be clean of contaminants since contaminants do not adhere well to sand grains.

6.3.1
Availability and Timing

Sand from offshore is continually available without temporal restrictions, but the relatively high costs of offshore dredging are a constraint that reduces project frequency. Large-scale projects that use sand from offshore are typically performed every five to ten years, depending on funding availability. For example, SANDAG's RBSP I occurred in 2001 and RBSP II may occur in 2011 or 2012.

There are many potential source locations for offshore sand in the San Diego region. SANDAG previously investigated the sites labeled as SO in North County, MB off Mission Beach, and SS off Silver Strand for RBSP I. SANDAG then extended the areas of interest around those sites, and investigated the new sites off Camp Pendleton (labeled as SM-1), Torrey Pines (TP-1), and Zuniga Shoal (ZS-1) for RBSP II. Sand quantities available from offshore sites can be huge, such as approximately 60 million cubic yards estimated to exist off Mission Beach at MB-1, and can be smaller, such as the more limited amount estimated to exist off Cardiff Beach at SO-6.

Projects using offshore sand may be constrained by weather when scheduled during fall to spring, and may extend through summer to capitalize on quiet ocean conditions for dredging and beach filling. Schedules may be restricted or additional construction monitoring required between March and the end of September depending on proximity to nesting areas of California least tern or snowy plover, and to maintain recreational uses.

Both SANDAG and the USACE envision performing large projects in the next ten years or less, and their efforts need to be coordinated to prevent significant cumulative impacts to essential fish habitat. SANDAG proposes placement of 2.1 million cubic yards of sand in 2011 or 2012. The USACE anticipates placement of a total of 950,000 cubic yards of sand at Encinitas/Solana Beach, a similar quantity of sand with retention measures at Oceanside, and 1.5 million cubic yards of sand at Imperial Beach. Dates for the USACE projects are uncertain due to federal budget uncertainties. It may be necessary for SANDAG to perform their work while this Coastal RSM Plan process continues, and for monitoring data from RBSP II to inform any future USACE efforts. The USACE can consider both the SANDAG monitoring results, the latest sand placement operations of other projects, and quantity targets of this Coastal RSM Plan to optimize their project quantities for region-wide benefits.

6.3.2
Transportation

Material dredged from offshore is transported to the littoral zone either by dredge discharge line to the nearshore or beach, or bottom dumped from scows or barges in the nearshore. No other transport mode is cost-effective for this scenario.

6.3.3
Receiver Sites for Offshore Sand

Sites within the San Diego region designated in this Coastal RSM Plan for receiving offshore sand are the onshore sites utilized in RBSP I, plus some additional nearshore sites. The RBSP I site boundaries are referenced in this document. It should be noted, however, that SANDAG intends to review and possibly modify the boundaries at some sites to improve performance or further minimize potential environmental effects based on monitoring results or more recent information.

SANDAG may also consider increasing placement quantities to increase their project effects and cost-efficiency. New nearshore sites are intended to lend flexibility and are located in areas where sensitive aquatic resource constraints are either absent or less extensive. The nearshore sites may also allow for reduced potential cumulative impacts from multiple placements. These nearshore sites can receive larger quantities of sand than onshore sites. Figures 37 through 39 show the following examples of potential receiver sites for offshore sand:

1. South Oceanside Beach onshore;
2. South Oceanside nearshore;
3. North Carlsbad Beach onshore;
4. South Carlsbad State Beach, onshore (north and south);
5. Batiquitos Beach (Encinitas) onshore;
6. Leucadia Beach onshore;
7. Moonlight Beach onshore;
8. Cardiff State Beach onshore;
9. Fletcher Cove onshore;
10. Del Mar onshore;
11. Torrey Pines State Beach onshore;
12. Mission Beach onshore;
13. Mission Beach nearshore;
14. Coronado Beach onshore;
15. Coronado Beach nearshore;
16. Imperial Beach onshore; and
17. Imperial Beach nearshore (south of pier).

Some of these sites are also positioned as “feeder” beaches to the rest of the region. Feeder beaches are those located upcoast of areas in need of nourishment that provide sand delivered by prevailing currents. Examples are South Oceanside Beach feeding North County beaches and Imperial Beach feeding South County beaches. South Oceanside Beach serves as a feeder beach

Figure 37 – Offshore Sediment Receiver Sites (North County)

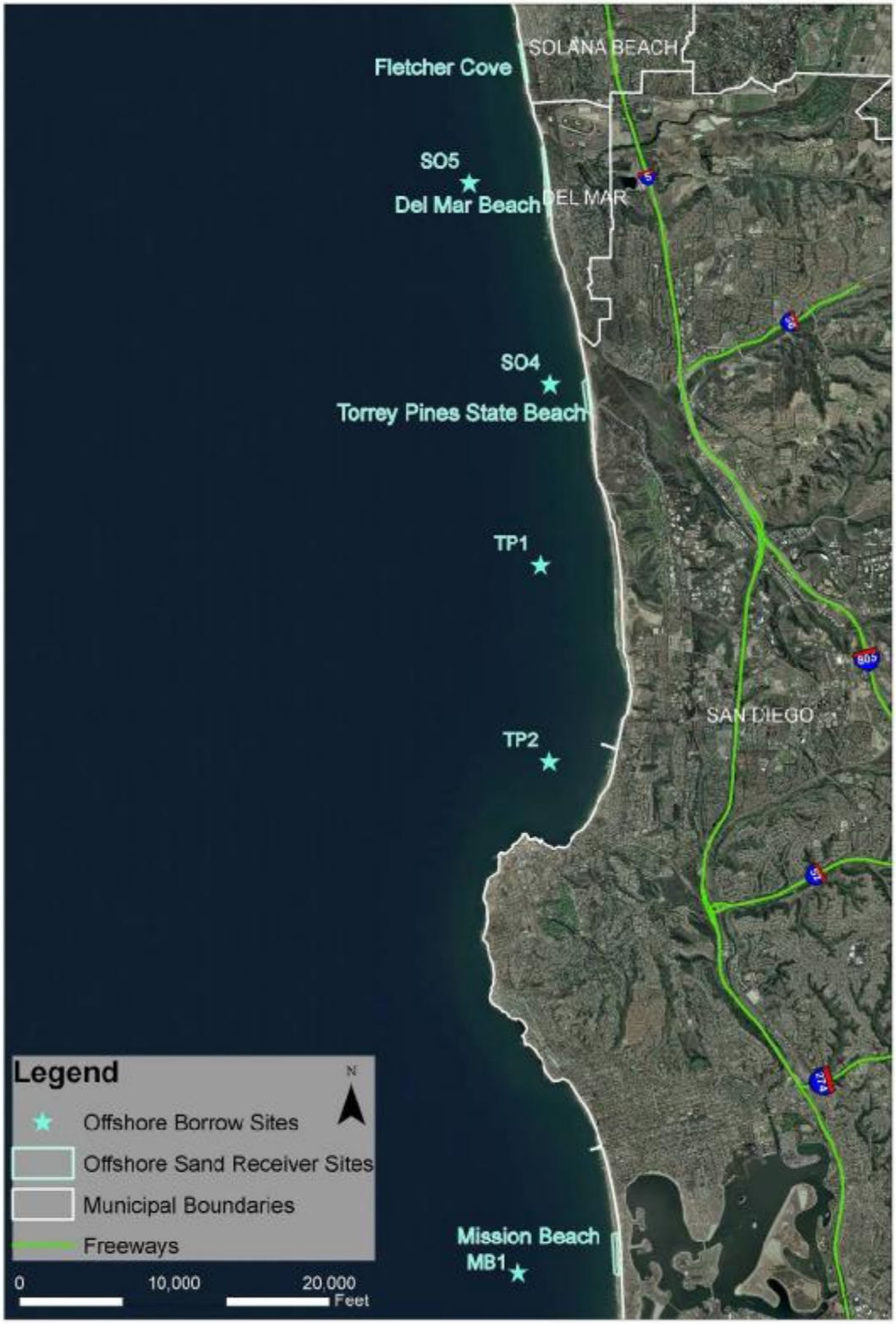


Figure 38 – Offshore Sediment Receiver Sites (Central County)

Figure 39 – Offshore Sediment Receiver Sites (South County)

to North County because longshore sediment transport is north to south and it is located at the northern end of the southern Oceanside littoral subcell. This is why both onshore and nearshore placement sites at South Oceanside that can accommodate large quantities of material are recommended. Similarly, the Imperial Beach placement site consists of both onshore and nearshore placement areas to accommodate large quantities of sediment that could then feed the coast to the north, as the net longshore drift is south to north at that location.

6.3.4
Habitat Considerations

Previously used beach receiver sites are recommended for use of offshore sediment sources due to the success of RBSP I at minimizing impacts. RBSP I demonstrated success of multiple placement locations increasing beach width within the region and minimizing environmental effects associated with large volume placements in localized areas (Coastal Frontiers 2004, AMEC 2005). RBSP I also varied the volume placed at individual sites according to environmental constraint considerations. Generally, larger volumes were placed at less constrained sites than receiver sites near sensitive resource areas. The inclusion of nearshore sites has the potential to increase flexibility and/or volume of sand placement in certain shoreline areas of the region that are less environmentally constrained.

Sufficient sediment is a limiting factor associated with seasonal development of the invertebrate community and functional use of the beach for spawning by grunion and foraging, resting, and/or nesting by shorebirds. When beaches are erosive, these habitat functions may be delayed until sufficient sediment has seasonally accreted to the beach. Beach nourishment has been shown to extend habitat suitability across seasons and/or enhance habitat functions in areas with pre-project erosive beach conditions (Melvin et al. 2001; CZR 2003, SAIC 2006).

Borrow site dredging includes habitat removal, damage, and disturbance of biota from operation of the dredge equipment and vessel anchoring. Other impacts are associated with sediment re-suspension and turbidity. Primary issues of concern include the potential for habitat modification, recovery rates of benthic fauna at the site, and proximity of dredging to sensitive resources. Habitat considerations associated with borrow site dredging include:

- Excavation depths and potential to alter sediment characteristics, hydrodynamics (e.g., wave transmission and effects to surfing), water quality, and/or recovery rates;
- Proximity to sensitive aquatic habitats (e.g., reefs, kelp beds);
- Proximity to spawning grounds or fishing areas; and
- Proximity to primary foraging locations of the California least tern during its breeding season.

Borrow site design may vary due to site conditions. However, reviews indicate that deep holes may result in altered water quality, such as decreased dissolved oxygen and increased hydrogen sulfide concentrations (NRC 1995). Recovery of the benthic community after borrow site dredging may be facilitated by shallow dredging over a larger area rather than creation of deep pits covering a limited area, dredging shifting sands rather than more stable bottoms, retaining

similar surface sediment type, and leaving undisturbed areas within the larger dredged area (Thompson, 1973; Hurme and Pullen, 1988; Jutte, 2002; Diaz, et al. 2004; SAIC, in review). Generally, relatively shallow pits minimize the potential to change hydrodynamics and promote recovery rates of benthic invertebrate forage base for secondary consumers (e.g., fish). Incorporating undredged refuge areas in the design of borrow site use may also speed recovery of the invertebrate forage base.

Potential turbidity or sedimentation are primary considerations in proximity to sensitive resources. Placement of offshore sands generally involves larger volumes than with opportunistic sand projects. Therefore, project duration may be an important consideration when sites are located near environmentally constrained areas. Placement of offshore sediments at nearshore sites is not recommended near sensitive habitats and should be limited to less environmentally constrained locations.

Limited information is available on nursery or spawning areas of commercial and recreation fishery species. Similar to nearshore sites, pre-project surveys to document existing conditions, and coordination with commercial fishermen to better understand local uses of the area, may be necessary to minimize potential adverse effects and to reduce conflicts with use of offshore borrow sites.

6.4 Bypassing of Offshore Sand from Marine Corps Base Camp Pendleton

Oceanside Harbor jetty is a large and effective sand retention structure in the San Diego region. The Oceanside harbor jetty system was first installed by the military during World War II, and expanded in the 1960s for the civilian boat harbor. Although not intended, the effect of the upcoast (north) jetty was to retain a wide sandy fillet against the jetty. To the present, this fillet has extended farther upcoast as deposition continued. Now, the fillet extends several miles north into MCB Camp Pendleton (DBW/ SANDAG 1994).

An estimate of the volume of sand existing in the fillet north of the Harbor is 3 million cubic yards (DBW/SANDAG 1994). Sand in the fillet is expected to be of very high quality as it has been transported longshore in the surf zone. The sand gradation is expected to be very coarse nearest the foot of the north jetty (upcoast side), and remain fairly coarse along the length of the fillet in the upcoast direction (Seymour, Personal Communication, June 2008). The sand should be clean of contaminants but this would need to be verified as the fillet is near a military base that could be a source of munitions or other contaminants.

This material would have been transported south into the southern portion of the Oceanside littoral cell had the jetty not retained it. Therefore, it represents an anthropogenic sediment sink that is also a large-scale source of new sediment for nourishment. Sand bypassing from this fillet represents one if not the most potentially productive contributions to the coastal sediment budget for the San Diego region. This material is accessible because it is in fairly shallow water within the littoral zone. SANDAG investigated an area partially within, and just offshore and upcoast, of this source in late 2008 for RBSP II and found it suitable for nourishment.

6.4.1
Availability and Timing

Sediment from this nearshore source could be removed by dredge and transported around the Harbor downcoast to replenish the southern littoral cell. A large volume is available in this area, but constraints on acquiring the material could be placed by MCB Camp Pendleton. Initial discussions between SANDAG and MCB Camp Pendleton officials have identified possibilities for bypassing the sediment. MCB Camp Pendleton personnel have initially indicated that their operational restrictions need to be considered, and that the dredge site should be located just north of the Santa Margarita River mouth. SANDAG will continue coordinating with MCB Camp Pendleton as their RBSP II project and sediment management activities move forward.

Dredging in the nearshore zone is typically undesirable because it can "rob" sediment from downcoast locations. However, in this instance there is no downcoast site as the north harbor jetty is a littoral barrier. No negative downcoast impact will occur from bypassing this fillet sediment around the Harbor. Sediment bypassing of the jetty would keep sediments in the nearshore on the downcoast side of the Harbor. Therefore, bypassing of this nearshore sediment could result in positive downcoast effects, including reduction of shoaling at Del Mar boat basin and Oceanside Harbor. This sediment bypassing would result in a bathymetric depression that should backfill rather quickly due to the relatively high southward littoral transport rates estimated for this reach of coast (USACE 1990 and 1991). Thus, this sediment bypassing could create a "sand trap" that could be regularly mined for high quality sand to nourish beaches downcoast of Oceanside Harbor.

Sediment bypassing of the Harbor could be performed at whatever frequency is needed and is economical to the region. This Coastal RSM Plan assumes it could occur every five to ten years depending on the availability of funding (similar to offshore dredging). This sediment bypassing concept is shown in Figure 40. This activity should occur from late spring through summer when there are likely to be quiet ocean conditions for dredging and beach filling. This project would need turbidity controls in place because this is also the nesting season for endangered coastal birds. However, the turbidity caused by this project should be fairly low because of the anticipated larger sediment grain size.

6.4.2
Transportation

Sediment bypassed from the harbor would be transported by dredge discharge line to the beach or nearshore, or bottom dumped from scows or barges in the nearshore. Other cost-effective transport modes do not exist. The USACE previously installed and operated a stationary sand bypass system in the early 1990s, but discontinued it due to low productivity and high costs (Moffatt & Nichol 1995). The bypassing method presented in this CRSM Plan is entirely different from the previous method employed by the USACE and should be more economical and effective.

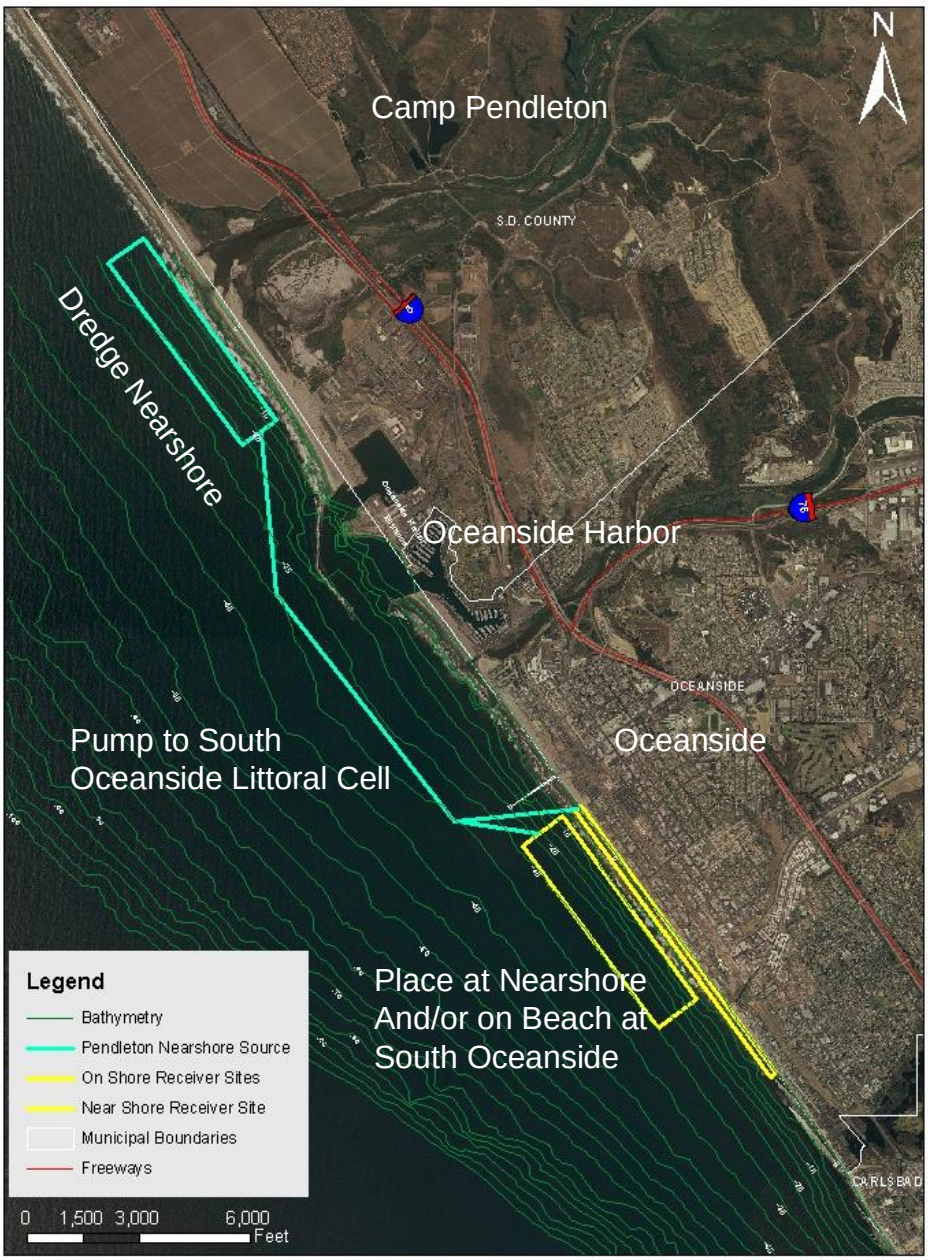


Figure 40 – Oceanside Nearshore Sediment Bypassing Concept

6.4.3
Receiver Sites

Receiver sites that could receive sediment from a nearshore sand trap off MCB Camp Pendleton and serve as feeder beaches would be those closest in proximity to the trap to reduce transport costs, and located at the upcoast end of the southern Oceanside Littoral subcell in order to increase benefits and residence time of the bypassed sediment through the southern littoral subcell. These sites include:

- South Oceanside Beach onshore; and
- South Oceanside Beach nearshore.

6.4.4
Timing of Nourishment

Sediment bypassing can be done as-needed to supplement nourishment from other sources. If insufficient sediment is placed over a year from opportunistic projects to meet annual goals, then the deficit could be made up by bypassing as an alternative to offshore dredging. The bypassing option may pose advantages over typical ocean dredging in that the sediment is shallower, optimum, and relatively close to the nearest receiver site.

Sediment bypassing could also be potentially used to even-out rates of nourishment to modest volumes over longer time periods, as compared to spikes of high volumes over short times that would occur during large offshore dredging projects. The timing of bypassing could specifically be managed to occur during windows of relatively low nourishment rates from other sources (i.e., plan for it to occur between larger SANDAG RBSP projects and other nourishment efforts such as those under consideration by the USACE).

6.4.5
Habitat Considerations

Dredging of nearshore sediment has the potential to disturb or degrade the subtidal habitat depending on the dredging frequency and its' potential to alter local hydrodynamics within the excavated area. Potential occurrence of Pismo clam beds and effects on essential fish habitat would require assessment. Proximity to least tern and snowy plover nesting areas on the beach just north of the Oceanside jetty may constrain the timing of bypassing operations depending on the potential for disturbance (e.g., noise or turbidity). Habitat considerations associated with placement of sands were further described in Section 6.1

6.5 All Sources or a Combination of Sources

The alternatives described previously in this report are based on the target nourishment occurring throughout the region from upland opportunistic sand sources, coastal maintenance or restoration, or sand from offshore dredging, to bracket the range of actions for costing and impact assessment. The most probable scenario will be that a number of sources will be used concurrently over time, rather than exclusive use of one type of source. For example, nourishment from upland sources could occur during time periods when lagoon and harbor maintenance dredging is also occurring. Therefore, coordination of nourishment activities may be needed to apply sediment to the region more evenly over time and space to maximize natural sediment retention and environmental sensitivity in the region, and minimize cumulative impacts (as opposed to periodic spikes leading to higher sand loss rates and potentially significant cumulative impacts).

6.5.1
Receiver Sites

Receiver sites for all possible sediment sources are shown in Table 12 and in Figures 41 through 45. The figures show:

- Proposed RSM sites for sand nourishment shown as yellow polygons;
- Lagoon restoration and lagoon/harbor maintenance sites recommended for proportional placement of sand shown as green polygons; and
- An area off South Oceanside nearshore that is moderately restricted due to rocky seabed conditions.

The entire network of placement sites constitutes the Coastal RSM Plan for San Diego County. Proposed RSM placement sites (solid yellow and green polygons on Figures 42-46) include both existing sediment placement sites used for previous projects and proposed new sites that would add flexibility to RSM efforts. Upland and offshore sand would be placed within yellow polygons. Sand from new lagoon restoration would be placed within solid green polygons. Existing lagoon and harbor maintenance receiver sites are shown as dashed green polygons on Figures 42-46 and are not changed from present use (unless indicated). These sites represent locations where proportional placement of sand should be considered to reduce the return of sand to lagoons and harbors after maintenance dredging. Certain sites may serve as both new nearshore RSM sites and new proportional placement sites, such as off the San Dieguito River and off Torrey Pines State Beach and are therefore colored as solid green. Several sites have multiple uses, such as receiving harbor or lagoon sediment, and offshore or upland sediment. These sites are shown by the yellow box overlaid by the dashed green box and include South Oceanside Beach, North Carlsbad State Beach, Torrey Pines State Beach, and Border Field State Park beach.

A total of 27 possible placement sites (some with multiple placement footprints) are incorporated into this Coastal RSM Plan to enable the greatest flexibility in sediment management. The majority of the sites have been used previously for sediment placement and some footprints have been enlarged to accommodate more sediment. Seven new sites are nearshore placement sites (off South Oceanside outside of a previous USACE placement area, off Batiquitos, off Cardiff State Beach, off San Dieguito Lagoon, off Torrey Pines State Beach, off Mission Beach, and off Coronado). The suite of receiver sites are proposed to maximize environmental sensitivity of long-term sediment placement within the region by spreading the placed sediment volume over more numerous and larger areas to reduce cumulative impacts (i.e., burial of sensitive resources, turbidity near bird nesting/foraging areas).

Modifications to some onshore sand placement sites may occur as part of the ongoing RBSP II planning effort. Certain cities have indicated a desire for either more or less sediment and for placement at slightly different locations other than those included in RBSP I. Therefore, some of the placement locations currently shown may change slightly in future adaptations to the Coastal RSM Plan.

Table 12 – Coastal RSM Plan Receiver Sites for All Sediment Sources

Site ID Number	Receiver Sites (New Sites and Changes to Existing Ones are Indicated)	Probable Source(s)
1.	South Oceanside Beach onshore (extended farther northward)	Harbor maintenance, upland, offshore and bypassing, Buena Vista Lagoon maintenance
2.	South Oceanside nearshore (new site over a majority of its area)	Harbor maintenance, Buena Vista Lagoon restoration, bypassing, offshore
3.	North Carlsbad State Beach onshore	Offshore, Buena Vista Lagoon restoration and maintenance
4.	Agua Hedionda onshore (north, central, and south footprint sites)	Agua Hedionda Lagoon maintenance
5.	South Carlsbad State Beach onshore (north and south)	Offshore and upland
6.	Batiquitos Lagoon Beach in Carlsbad onshore (north and south)	Offshore, Batiquitos Lagoon maintenance
7.	Batiquitos nearshore (new site)	Batiquitos Lagoon maintenance
8.	Batiquitos Beach in Encinitas onshore	Offshore, upland
9.	Leucadia Beach onshore	Offshore
10.	Moonlight Beach onshore	Offshore, upland
11.	Cardiff State Beach onshore	Offshore, upland, San Elijo Lagoon restoration and maintenance
12.	Cardiff nearshore (new site)	San Elijo Lagoon restoration
13.	Fletcher Cove onshore	Offshore, upland
14.	San Dieguito Lagoon nearshore (new site)	San Dieguito Lagoon ocean channel restoration
15.	San Dieguito Lagoon onshore (new sites north and south of the mouth)	San Dieguito Lagoon maintenance
16.	Del Mar onshore	Offshore
17.	Torrey Pines State Beach onshore	Offshore, upland, Los Peñasquitos Lagoon restoration and maintenance
18.	Torrey Pines State Beach nearshore (new site)	Los Peñasquitos Lagoon restoration
19.	Mission Beach onshore	Offshore
20.	Mission Beach nearshore (new site)	Mission Bay maintenance, offshore
21.	Ocean Beach onshore (new site)	Upland
22.	Coronado Beach onshore	Upland, offshore
23.	Coronado Beach nearshore	San Diego Bay maintenance, Offshore
24.	Imperial Beach onshore	Offshore, upland
25.	Imperial Beach nearshore north	San Diego Bay maintenance, offshore
26.	Imperial Beach nearshore south (enlarged from USACE site)	San Diego Bay maintenance, Tijuana Estuary restoration, offshore
27.	Border Field State Park onshore	Upland – debris basins

Figure 41 – North County Regional Receiver Sites

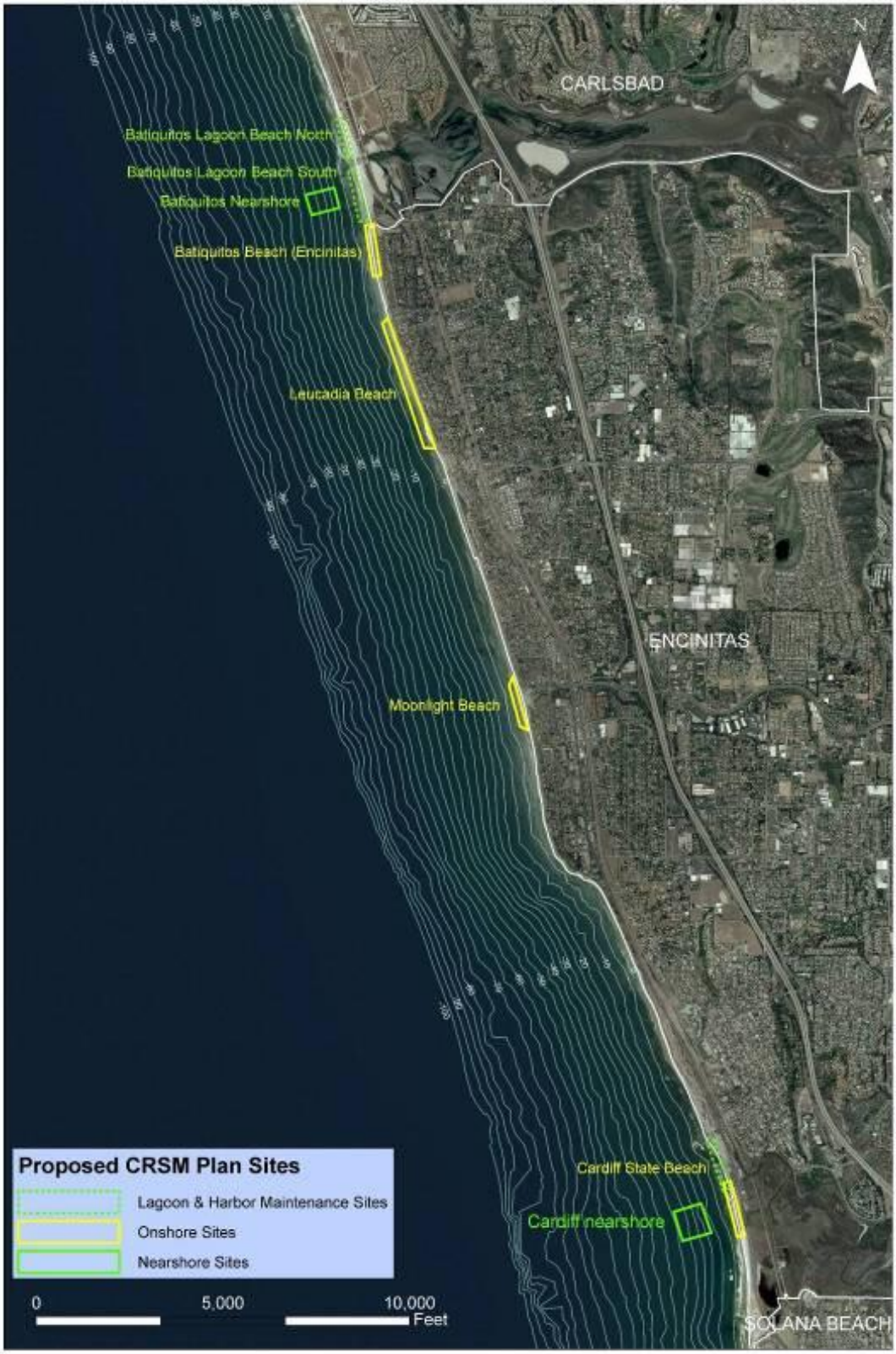


Figure 42 – North Central County Regional Receiver Sites

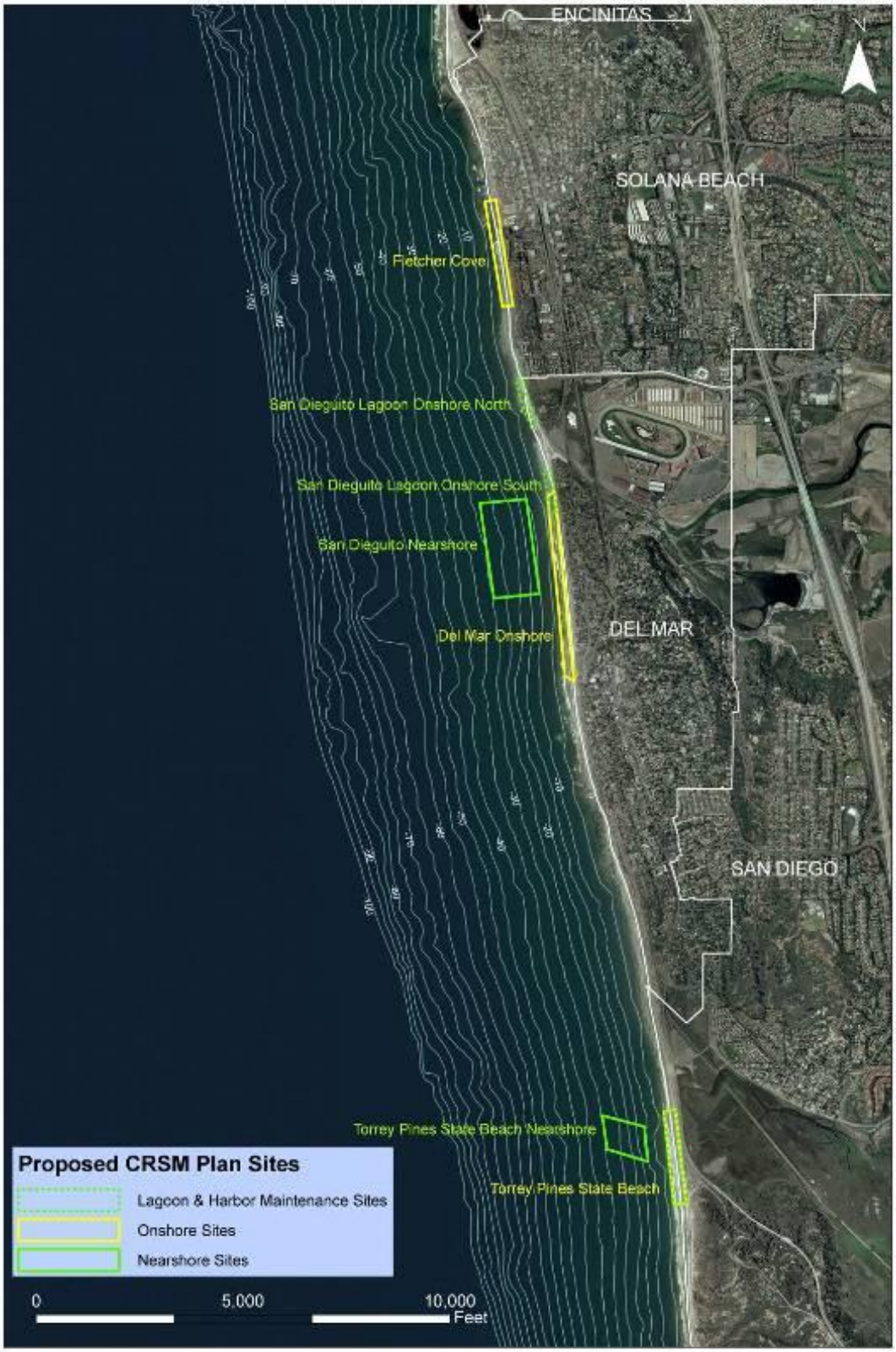


Figure 43 – Central County Regional Receiver Sites

Figure 44 – South Central County Regional Receiver Sites

Figure 45 – South County Regional Receiver Sites

6.5.2
Timing of Nourishment

Nourishment should be coordinated to eliminate large sediment pulses and associated resource impacts, and reduce potential large-scale losses from storms. Sediment applied to the region evenly over time and space, as opposed to periodic spikes, may maximize natural sediment retention and environmental sensitivity in the region and minimize cumulative impacts. In contrast, periodic spikes of high sediment input may result in higher sediment loss rates during storms and potentially significant cumulative impacts.

The timing of less frequent and larger projects by SANDAG and the USACE should be planned to occur during windows of lower nourishment rates (i.e., occur "around" maintenance actions and opportunistic beach fill efforts) to achieve a consistent rate of 1 million cubic yards of sand added to the region annually, and dispersed as broadly as possible during placement to benefit the greatest area of all three littoral cells.

The timing of projects also is an important consideration to adaptive management of the Plan. Magnitude and frequency of disturbance are important cumulative impact considerations. However, factors such as sediment volume and disturbance frequency will vary among placement sites depending on local uses and site specific conditions. Monitoring will be conducted to support refinement of the regional sediment management strategy, including timing and frequency of nourishment activities. Monitoring of both physical and biological parameters is recommended to support decisions for optimizing performance of sediment management projects while ensuring that environmental protection objectives are met.

6.5.3
Habitat Considerations

Habitat considerations associated with coordinated sediment management activities involving a variety of sand sources include those previously described for different project elements (Sections 6.1.4, 6.2.4, 6.2.6, 6.3.4, and 6.4.5). Foremost considerations include avoidance and minimization of potential adverse effects to sensitive habitats and resources during project implementation. Various strategies may be considered to avoid or minimize negative impacts, including restrictions on volumes, frequency, timing, or placement location relative to proximity to sensitive resource constraints.

Other important considerations are pertinent to minimizing potential adverse cumulative impacts. Sand placement strategies that maximize early season placement and avoidance of repetitive placement at the same beach locations within the same year would facilitate invertebrate recovery rates and protection of the forage base for fishes and shorebirds. Borrow site use also may be designed to facilitate recovery and protection of the benthic forage base by incorporating un-dredged refuge areas within the site boundaries and avoiding creation of deep pits. Pre-project surveys and coordination with commercial fishermen to better understand nearshore resources and uses may be effective for minimizing potential adverse cumulative impacts and reducing conflicts.

Enhancing functional quality of beaches in erosive areas and providing more persistent quality habitats for biota are important objectives of the sediment management strategy. Sediment placement that contributes to more persistent sediment across seasons has the potential to improve habitat quality for California grunion spawning, invertebrate forage base for shorebirds, and quality of critical habitat and wintering areas for threatened snowy plover.

7.0

SOLUTIONS

Existing nourishment practices are composed of actions that occur sporadically over time and space that may not optimally address the issue of coastal erosion. Existing practices tend to show a pattern when analyzed comprehensively. Tables 13, 14, and 15 show existing nourishment projects, quantities and timing that have been documented since 1993 (Coastal Frontiers 2007), and projected activities out into the future to 2015 based on these existing patterns. SANDAG RBSP II in 2011 or 2012 is included. This information shows the amount of sediment placed over time within each littoral cell, and compares that against the target rate needed to meet SANDAG's goal of increasing the sediment volume in the region by 30 million cubic yards (SPS 1993). Existing sediment placement quantities include maintenance dredging that is not considered new littoral material. However, this analysis is intended to generally show trends of whether existing activities meet the target or not, so detailed breakdown of projects is not performed. The targeted nourishment rate and timing is shown compared to existing rates, with recommended future nourishment rates to obtain SANDAG's goal indicated. Alternatives for management should focus on meeting the overall quantity target for the region, while avoiding adverse impacts by adjusting the timing, quantities, and possible locations of nourishment. Four options to accomplish nourishment of the region at the target rate are described below.

The alternatives are presented relative to sediment management devices. Sediment management with devices refers to modification of a site sufficiently with a device to cause sand to remain in place longer than would otherwise occur without a device. Structural sediment management devices consist of reefs that can be both submerged and emergent, naturalized headlands, artificial groins, breakwaters, harbor jetties, permeable pile piers, and possibly other features yet to be identified. No specific proposal is offered herein for sediment management devices, although the advantages associated with their use are discussed in a subset of alternatives. Long-term management of the region's shoreline is much more cost-effective using sediment management devices versus not using such devices (Moffatt & Nichol 2001; SANDAG internal documentation 2007; Everts 2002; California State Coastal Conservancy 2002). The effectiveness of using sand management devices in the San Diego region is still being researched by SANDAG, but other researchers believe it will be necessary to accomplish regional sand management (DBW/SANDAG 1994; Flick, Personal Communication 2008; Everts, Personal Communication, 2008). More sand is required for regional management over the long-term without sediment management devices.

While the concept of using sediment management devices is more economical over the long-term, it presents challenges of potential adverse environmental impacts, social acceptance, high initial costs, and engineering. These issues require serious consideration of this approach, but it can be implemented sensitively in San Diego County. San Diego County already possesses existing unintended sediment management devices that serve as examples (e.g., Oceanside

Table 13 – Approximate Planned and Actual Sediment Placement Quantities, North County San Diego From 1993 to 2015

	TIME																						
								2000										2010					
PROJECT	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SANDAG RBSP																							
OCEANSIDE HARBOR MAINTENANCE																							
AGUA HEDIONDA LAGOON MAINT.																							
BATIQUITOS LAGOON MAINT.																							
SAN ELIJO LAGOON MAINTENANCE DREDGING																							
OPPORTUNISTIC PROJECTS																							
Batiquitos Lagoon Restoration																							
Lomas Santa Fe Grade Separation																							
Descanso/Carlsbad Bl. Lot Division																							
Santa Margarita River Desiltation																							
U.S. Navy Homporting																							
Agua Hedionda Facilities Modification																							
North County Commuter Rail Project																							
Pacific Station Mixed Use Project																							
Solana Beach Mixed Use Project																							
CUMULATIVE AMOUNT																							
OVERALL TARGET RATE WITHOUT SAND RETENTION																							
RESULT	LO	LO	HI	LO	LO	LO	LO	LO	HI	LO	LO	LO	LO	LO	LO	LO	LO	LO	HI	LO	LO	LO	LO
ADDITIONAL NEED TO NOURISH (YES -Y OR NO-N?)	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
MINIMUM QUANTITY FOR NOURISHMENT NEEDED																							
WITHOUT SAND RETENTION																							
OVERALL TARGET RATE WITH SAND RETENTION																							
RESULT	LO	OK	HI	OK	OK	OK	LO	LO	HI	OK	OK	LO	LO	LO	OK	LO	LO	LO	HI	LO	OK	LO	LO
ADDITIONAL NEED TO NOURISH (YES -Y OR NO-N?)	Y	N	N	N	N	N	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y
MINIMUM QUANTITY FOR NOURISHMENT NEEDED																							
WITH SAND RETENTION INCLUDED																							

Actual sand placement data from SANDAG 2006 Regional Beach Monitoring Program Annual Report by Coastal Frontiers, April 2007

COLOR	NEW SAND VOLUME
	1.5 - 2 MCY
	1 - 1.5 MCY
	0.5 - 1 MCY
	0.25 - 0.5 MCY
	0.25 MCY
	0 - >0.25 CY
	0 CY

TARGET - NO RETENTION = 1 MCY/YR

TARGET - WITH RETENTION = 0.5 MCY/YR

Table 14 – Approximate Planned and Actual Sediment Placement Quantities, South County San Diego From 1993 to 2015

	TIME																						
								2000										2010					
PROJECT	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SANDAG RBSP																							
U.S. Navy Pier 2 Dredging																							
U.S. Coast Guard Ballast Point Dredging																							
SIO Nimitz Marine Facility Dredging																							
San Diego Harbor Maintenance Dredging																							
Tijuana Estuary Tidal Restoration Project																							
Seacoast Inn - Imperial Beach																							
North Island Naval Air Station Improvements																							
San Diego Harbor Dredging																							
CUMULATIVE AMOUNT																							
OVERALL TARGET RATE WITHOUT SAND RETENTION																							
RESULT	LO	LO	OK	LO	LO	LO	LO	LO	LO	LO	LO	OK	LO	LO	LO	OK	LO	LO	LO	LO	LO	LO	LO
ADDITIONAL NEED TO NOURISH (YES -Y OR NO-N?)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
MINIMUM QUANTITY FOR NOURISHMENT NEEDED																							
OVERALL TARGET RATE WITH SAND RETENTION																							
RESULT	LO	LO	HI	OK	OK	LO	LO	LO	OK	LO	LO	HI	LO	LO	LO	HI	LO	LO	OK	LO	LO	LO	LO
ADDITIONAL NEED TO NOURISH (YES -Y OR NO-N?)	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y
MINIMUM QUANTITY FOR NOURISHMENT NEEDED																							

Actual sand placement data from SANDAG 2006 Regional Beach Monitoring Program Annual Report by Coastal Frontiers, April 2007

COLOR	NEW SAND VOLUME
	1.5 - 2 MCY
	1 - 1.5 MCY
	0.5 - 1 MCY
	0.25 - 0.5 MCY
	0.25 MCY
	0 - >0.25 CY
	0 CY

TARGET - NO RETENTION = 1 MCY/YR

TARGET - WITH RETENTION = 0.5 MCY/YR

Table 15 – Approximate Planned and Actual Sediment Placement Quantities, Central County San Diego From 1993 to 2015

	TIME																						
								2000															
PROJECT	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SANDAG RBSP																							
U.S. Navy Homporting																							
CUMULATIVE AMOUNT																							
OVERALL TARGET RATE WITHOUT SAND RETENTION																							
RESULT	LO	LO	LO	LO	OK	LO	LO	LO	OK	LO	LO	LO	LO	LO	LO	LO	LO	LO	OK	LO	LO	LO	LO
ADDITIONAL NEED TO NOURISH (YES -Y OR NO-N?)	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
MINIMUM QUANTITY FOR NOURISHMENT NEEDED																							
NOTE: SAND RETENTION ALREADY EXISTS AT MISSION BAY ENTRANCE CHANNEL JETTY NORTH																							
Actual sand placement data from SANDAG 2006 Regional Beach Monitoring Program Annual Report by Coastal Frontiers, April 2007																							

COLOR	NEW SAND VOLUME
	1.5 - 2 MCY
	1 - 1.5 MCY
	0.5 - 1 MCY
	0.25 - 0.5 MCY
	0.25 MCY
	0 - >0.25 CY
	0 CY

TARGET - NO RETENTION = 1 MCY/YR

TARGET - WITH RETENTION = 0.5 MCY/YR

Harbor North Jetty, Agua Hedionda North Jetty, Mission Bay Entrance Channel North Jetty) and are addressed in the Regional Sand Retention Strategy (Moffatt & Nichol 2001).

Sediment management devices are not necessarily assumed to be constructed within the region, however they are included in two Alternatives to remain within the universe of options for analysis and consideration. Assumptions made for the Alternatives that incorporate sediment management devices are that: 1) sediment management devices are installed at multiple sites experiencing acute erosion, 2) they would benefit adjacent beaches, and 3) would not result in a significant adverse environmental impact.

The range of possible sediment management device scenarios is extremely broad and as yet undetermined. SANDAG plans to perform extensive analyses of potential sediment management devices with input from regional stakeholders in the future to clarify possibilities. Assessment of nourishment sites utilizing sediment management devices needs to consider research being done by SIO (O'Reilly 2008) on lagoon subcells of sediment movement within the region. Initial collaboration has occurred with SIO relative to this Coastal RSM Plan, but more coordination and information sharing is needed to adaptively manage implementation of the Plan.

The types of sediment management devices would likely vary and are not specified. They are assumed to be devices that cause formation of a significant dry beach area in its area of influence. This region, however, has clearly expressed a preference in comments made at previous SPWG meetings for a submerged reef concept due its advantages of being less obtrusive to views, providing increased rocky bottom habitat and improved surfing conditions, thus being more politically and publicly acceptable. The submerged reef concept requires significant research and design investigations before it can be proven to work in this region and under rising sea level, and SANDAG has initiated those efforts and plans to expand on them, contingent on funding assistance from the state.

All sediment management devices require pre-fill with sand to prevent downcoast impacts. Existing natural and artificial sediment management devices include the list below with some described in DBW/SANDAG (1994):

- Groins, with variations on the traditional groin to create a shorter version with a T shape (T-groins) – function by intercepting longshore sand transport from two directions;
- Reefs, with variations from exposed to submerged – function by sheltering the beach from wave energy;
- Pier piles, enlarged and more densely spaced at piers to cause sand deposition – function by reducing wave energy and longshore transport through the structure;
- Deltas, emulating effects of the Tijuana River delta and the San Mateo Creek delta – function by refracting waves offshore and sheltering the beach from wave energy;
- Headlands, such as Dana Point – function by blocking longshore transport; and
- Breakwaters – function by blocking wave energy and sheltering the beach.

Another concept called Pressure Equalization Modules (PEMs) has been implemented in Denmark and Sweden, with plans for pilots in Florida. They reportedly function by dewatering the beach and reducing fluidization of beach sediment. The PEMs system does not yet have a proven record of performance in higher wave energy environments such as along the California

coast, so they are not considered as options in this plan. However, as new technologies such as PEMs continue to emerge, they will be considered for potential use in the San Diego region.

7.1 Alternative 1 - One Million Cubic Yards Per Year Without Sediment Management Devices

In the absence of sediment management devices, a minimum of 1 million cubic yards per year of new sediment will be needed for recovery of the beaches in the region over approximately half a century, accounting for estimated dispersion or losses. Without sediment management devices, more sediment is required to restore the region in order to account for losses of sediment to the downcoast and offshore areas. For purposes of proposing possible scenarios, two different types of sediment sources are considered. Sediments from harbor and lagoon maintenance are not considered new sources in these scenarios, since they are simply recycling sand back into the littoral cells from temporary offline storage.

7.1.1
Scenario 1 - Sediment from Upland Sources and From Offshore Dredging

In one scenario, it is assumed that existing and foreseeable opportunistic beach fill programs that utilize upland sediment throughout the region are active to a maximum extent over their 5-year permit periods. If all the current upland beach fill programs provide their maximum permitted amounts of sediment placement each year, a total of 895,000 cubic yards of sediment per year could be input to the region's coast (Table 16). Of this, a general maximum of 25 percent fine-grained materials is permitted, so the net quantity of sand that could be placed could range from 671,000 cubic yards per year (assuming all material consists of 25 percent of fines) to 895,000 cubic yards per year (assuming 0 percent fines content). It is possible that additional upland sediment receiver sites could be added to existing programs or as a new program associated with this Coastal RSM Plan in order to reach the 1,000,000 cubic yards goal.

In the absence of new opportunistic beach fill sites, the balance of sediment to nourish the region each year at the target rate of 1,000,000 cubic yards per year could come from offshore sources. The balance needed would be between approximately 105,000 cubic yards per year and 328,750 cubic yards per year. This supplement could occur annually or less frequently (such as 525,000 cubic yards to 1,643,750 cubic yards every five years) to reduce the high project costs associated with equipment mobilization for offshore dredging. Table 17 shows a possible scenario with sediment provided from both upland and offshore sources.

The quantities in the Table exceed the target of 1 million cubic yards to the region because they specify the probable allowable maximum placements proposed for each site. All totaled, they exceed the annual target by 2.5- to 3-fold. This situation provides flexibility to the region, as it can pick and choose the sites used for beach nourishment to optimize nourishment operations. The region is capable of receiving more than 1 million cubic yards per year, and can sensitively nourish the coast by remaining within that target quantity and using various receiver sites to minimize potential adverse impacts. Alternatively, the region could take advantage of opportunities available and place more material than necessary in a given year, leaving less needed for subsequent years.

Table 16 - Maximum Existing and Future Upland Beach Fill Program Quantities

UPLAND BEACH FILL PROGRAMS AND QUANTITIES		
Receiver Site	**Quantity (cubic yards)**	**Less 25% Fines**
South Oceanside Beach	150,000	112,500
South Carlsbad State Beach	150,000	112,500
Batiquitos Beach (Encinitas)	120,000	90,000
Moonlight State Beach	150,000	112,500
Fletcher Cove	150,000	112,500
Coronado	100,000	75,000
Imperial Beach	75,000	56,250
TOTAL	895,000	671,250

Table 17 - Possible Quantities for the Scenario of Upland and Offshore Sediment Combined

Receiver Site	Allowable Quantity at Each Receiver Site (Cubic Yards)	Less 25% Fines for Terrestrial Sand (Sites Without Upland Sediment Do Not Change)
South Oceanside	150,000	112,500
South Oceanside Nearshore (No upland sediment)	150,000	150,000
North Carlsbad (No upland sediment)	250,000	150,000
South Carlsbad State Beach north area	150,000	112,500
Batiquitos Lagoon Beach (Carlsbad) (No upland sediment)	150,000	150,000
Batiquitos Beach Nearshore (No upland sediment)	150,000	150,000
Batiquitos Beach (Encinitas)	120,000	90,000
Leucadia Beach (No upland sediment)	100,000	100,000
Moonlight Beach	150,000	112,500
Cardiff State Beach	100,000	75,000

(cont.)

Receiver Site	Allowable Quantity at Each Receiver Site	Less 25% Fines
Cardiff Nearshore (No upland sediment)	150,000	150,000
Fletcher Cove	150,000	112,500
Del Mar Beach (No upland sediment)	120,000	120,000
Torrey Pines State Beach	150,000	112,500
Torrey Pines Nearshore (No upland sediment)	150,000	150,000
Mission Beach (No upland sediment)	100,000	100,000
Mission Beach Nearshore (No upland sediment)	100,000	100,000
Ocean Beach	100,000	75,000
Coronado Beach	100,000	75,000
Coronado Nearshore (No upland sediment)	100,000	100,000
Imperial Beach	75,000	56,250
Imperial Beach Nearshore (No upland sediment)	75,000	75,000
TOTAL	**2,840,000**	**2,453,750**

Sources of upland sediment are numerous and widespread in distribution. It is assumed that this sediment will come from upland areas within 20 miles of the coast, and probably much closer. Sources of offshore sediment are less numerous and located at distinct sites. It is assumed that offshore sediment would come from the sources previously discussed in Section 5 and possible new ones subsequently identified. Upland sediment would be delivered primarily by truck over the existing road network. Offshore sediment would be delivered by either hopper or hydraulic dredge.

7.1.2
Scenario 2 - Offshore Dredging Alone

The other scenario to reach the 1,000,000 cubic yards goal for regional beach nourishment without sediment management devices assumes that upland opportunistic beach fill programs are not productive and result in no sediment contribution to the coast. Under this scenario, all sediment is dredged from offshore and delivered to the coast at a rate of approximately 1,000,000 cubic yards per year. This work would be done annually, or on a less frequent basis (such as 5,000,000 cubic yards every five years depending on economics and funding) to keep mobilization costs down. Sediment sources would come from the sources previously discussed in Section 5 and possible new ones subsequently identified.

7.1.3
Summary of Performance Without Sediment Management Devices

Nourishment under existing conditions without sediment management devices requires a higher nourishment rate over time, larger quantities, and more mobilizations but lacks a significant initial investment to install the sediment management device (Moffatt & Nichol 2001). Internal SANDAG (2007a) cost estimates indicate that without sediment management devices, nourishment-only within the region over 40 years may cost up to $395 million. With sediment management devices and nourishment the cost may reach up to $299 million over 40 years. The Regional Beach Sand Retention Strategy (Moffatt & Nichol 2001) shows, for example, that costs to nourish a beach to maintain an area in North County equivalent to that retained by a device for 50 years reaches up to $57 million, while it reaches $33 million with a device. Thus, actions specified in this CRSM Plan would cost more over the 50-year planning horizon, take longer to add approximately 30 million cubic yards to the region, and may lead to greater cumulative impacts as a result. However, the challenges of securing project approvals and the potential of causing significant environmental impacts over the short-term are reduced without sediment management devices. Short-term costs are lower under this scenario compared to the with-sediment-management devices scenario.

7.1.4
Habitat Considerations

Habitat considerations associated with coordinated sand management activities involving a variety of sand sources include those previously described and summarized in Section 6. An important objective of sand management planning is to guide sediment procurement and placement to address coastal erosion and deficit concerns in a way that avoids or minimizes impacts to sensitive habitats and resources. Dredging and sediment placement are disruptive activities and some impacts to essential fish habitat and invertebrate forage base are unavoidable. Depending on work location or time of year, there also may be resource constraints associated with proximity to sensitive habitats (e.g., reefs, surfgrass beds, kelp forests/beds) and breeding or wintering concentration areas for some endangered or threatened species. Appropriate mitigation measures would be necessary during pre-project activities and construction to avoid and minimize effects below a level of significance. Compensatory mitigation may be required if there are unexpected significant adverse effects.

Sediment management strategies that vary according to different sand volume and source combinations (e.g., opportunistic, maintenance dredging, and offshore sediment) have different impact considerations relative to activities being conducted primarily onshore, offshore, or some combination between. These differences not only are important considerations specific to receiver sites, but also are important to cumulative impact considerations. Environmental assessment and review of potential implementation alternatives would be addressed in the appropriate CEQA or CEQA/NEPA document subject to public comment and resource and regulatory environmental review and permitting.

7.2 Alternative 2 - One Half Million Cubic Yards of Sediment Per Year with Sediment Management Devices

With sediment management devices, less sediment would be required to nourish the region annually because less sediment would be lost from, and dispersed within the littoral cell. For purposes of this Plan it is assumed that sediment management devices would reduce the needed annual nourishment amount by approximately 50 percent. This reduction in the nourishment rate associated with sediment retention is an educated guess and certainly open to debate, justification, and modification. It is also dependent on the type of sediment management devices conceived, their size, their distribution throughout the region, and their number. A future task to define the reduction in nourishment realized by using sediment management devices is required. Acknowledging this uncertainty, for purposes of this plan it is assumed that up to 500,000 cubic yards of sediment would be needed each year to restore the beaches in the region over approximately half a century with sediment management devices in place. Similar to the project scenarios without sand management devices, the two different types of sediment sources considered are upland sediment and offshore sediment.

7.2.1
Scenario 3 - Sediment Management Devices With Sediment From Opportunistic Beach Fill

In the upland sediment scenario, opportunistic beach-fill programs throughout the region are assumed to be active to the maximum extent over their permit lives. As described above, a total of 895,000 cubic yards per year would be input to the region's coast if all upland beach-fill programs result in their maximum permitted amounts of sediment being placed each year. Further, if all materials consist of up to 25 percent fine-grained particles, the net quantity of sediment that would be placed could range from 671,000 cubic yards per year (assuming all material consists of 25 percent of fines) to 895,000 cubic yards per year (assuming 0 percent fines content). Therefore, existing upland beach-fill programs could provide enough sediment to entirely nourish the region's coast if sufficient sediment management devices were deployed.

7.2.2
Scenario 4 - Sediment Management Devices with Sediment from Offshore Dredging

As with the no-sediment-management devices option, one scenario considered for beach nourishment with sediment management devices assumes that upland beach-fill programs are not productive and result in little or no sediment contribution to the coast. Under this scenario, all sediment is dredged from offshore and delivered to the coast at a rate of approximately 500,000 cubic yards per year. This work could be done annually, or on a less frequent basis (such as 2,500,000 cubic yards every five years) to keep mobilization costs down. Sediment sources would be all possible offshore sites identified by SANDAG and others.

7.2.3
Summary of Performance with Sediment Management Devices

Nourishment under modified conditions with sediment management devices would require a lower nourishment rate over time and smaller quantities for each project as compared to a scenario without sediment management devices, but with a significant initial structural investment. Thus, using sediment management devices costs less over the long-term, but more over the short-term. Also, the project would potentially take less time to accomplish the goal of adding approximately 30 million cubic yards to the region, and may lead to less cumulative impacts as result. However, the challenges of securing project approvals and the potential of causing significant environmental impacts over the short-term are greater with sediment management devices.

7.2.4
Habitat Considerations

Habitat considerations associated with coordinated sediment management activities involving sediment retention include those summarized in Sections 6 and 7.14. In addition, there are impact considerations associated with construction and effects of sediment management devices. Some effects would be limited to the period of construction of the sediment management device (e.g., turbidity, noise) while other effects would be long-term, such as conversion of soft-bottom habitat in the footprint of the structure. Other effects would relate to the type of materials and design of chosen device(s).

Although many of the same cumulative impact considerations described above for implementation without sediment retention also apply to alternatives involving sediment retention, other considerations are unique to sediment retention. An important difference associated with reduced placement volumes in the region is the potential for less frequency of disturbance of nearshore and beach habitats to achieve longer project performance. An important consideration is the potential for the sediment management device to provide habitat functions for biota. Hard bottom that provides structural relief may provide artificial reef functions and values. This may be an important consideration when evaluating potential cumulative impacts.

7.3 Recommended Plan

The recommended Alternative for regional sediment management in the San Diego Region is: 1) nourishment with one-half million cubic yards of offshore sediment, 2) supplemented with sediment from upland, lagoon restoration, and maintenance dredging, with 3) sediment management devices if they are proven to be effective. The upland and offshore sources scenarios can both provide the necessary amount of sediment, assuming that the upland beach fill programs contribute the full amount. To best prepare contingencies, offshore sources should continue to be pursued as the most viable scenario.

Assuming sediment management devices are proven to be effective, this Alternative provides the greatest potential for realizing the long-term goal of increasing the sediment volume within the

region by approximately 30 million cubic yards. The beneficial effects of sediment management increases the probability that the sediment volume in the region can be increased over time without being lost and dispersed during severe storms. This Alternative represents the best option to reduce the time period and quantity of sediment required over time to achieve the target volume increase.

In addition, proportional placement of maintenance-dredged sediments from lagoons and harbors should occur to maximize the residence time of sediment within the littoral cell and to reduce shoaling of these sites from sediment return. Sediment that becomes available from lagoon restoration can supplant or enhance the volumes obtained from either upland or offshore sources, and bypassing the sediments trapped upcoast of Oceanside Harbor to downcoast beaches may be the single most effective way to accomplish SANDAG's goal.

8.0

ADDITIONAL CONSIDERATIONS OF ALTERNATIVES

Additional considerations for the regional sediment management Alternatives presented in Section 7 include economics (costs versus benefits), funding sources, and permit requirements. These additional considerations are discussed below.

8.1 Economic Feasibility

Economic feasibility of regional sediment management depends on project costs and project benefits. Typically, if the benefits outweigh the costs (i.e., the ratio of benefits to costs is greater than 1.0) the project is economically feasible at a conceptual stage.

8.2 Program Costs

Program costs include those for planning, engineering, construction, maintenance, monitoring and reporting, and potential mitigation. Cost estimates for the two major alternatives (nourish with and without sediment management devices and sub-alternative Scenarios of using upland or offshore sediment) are shown as annualized costs in Table 18 and in Appendix D. The Coastal Sediment Benefits Analysis Tool (CSBAT) developed for CSMW by the USACE (Everest, 2008) was used for reference information to estimate certain project costs. Annualized costs are those required on a yearly basis to implement the regional program, perform on-going renourishment, and monitoring and maintenance. As shown in Table 18, the costs associated with the no sediment management devices Alternative range from $18 million using only offshore dredged sediment, to $37 million using only upland sediment. In comparison, costs associated with the Alternative that includes sediment management devices vary from $16-$26 million, depending on whether offshore or upland sediment sources are used, respectively.

The least expensive Scenario is the use of offshore sediment alone, based on the costs to truck material throughout the region. If trucking and handling of the material can be minimized, costs to implement projects using upland sediment will decrease and become more in line with costs to dredge from offshore.

In 2007, SANDAG performed a separate cost estimate predicting a total 40-year project cost (SANDAG 2007a) assuming that sediment management devices are proven to be effective. SANDAG found that costs to nourish every five years without sediment management devices would total $395 million over the 40-year period, while the total cost to implement sediment management devices with nourishment every ten years (50% reduction in nourishment) would be $299 million. Thus, cost savings of $96 million, or 25 percent, could be realized over 40 years through implementing sediment management devices and nourishment compared to nourishment only.

8.3 Program Benefits

Benefits associated with the recommended regional program include increased recreation from wider beaches, increased sandy beach and hard bottom habitat areas, reduction of damage to infrastructure from increased shore-property protection, increased public safety, reduced emergency services cost, reduced clean-up costs, increased tax revenues to local agencies, and potential other factors. Benefits were estimated using a method developed by Dr. Phil King and used by SANDAG (2007b) that includes recreation and protection of public property. The CSBAT model was not used to estimate benefits because the model is focused only on certain sites that do not include all the RSM sites, and therefore the model code would have to be modified to estimate benefits at all RSM sites. The annual benefits of the project, regardless of Alternative or Scenario, are estimated at approximately $18.7 million. This estimate is based on the benefits specified in the SANDAG Feasibility Study (2007b) for the square footage of new beach created by either adding sediment to the region at the target rate of 1 million cubic yards per year without sediment management devices or adding 500,000 cubic yards per year of sediment to the region every year with sediment management devices.

Using these values (Table 18) the benefit-to-cost (B/C) ratio for the regional program with no sediment management devices ranges from between 0.5 for Upland Sediment Scenario to 1.0 for the Offshore Sediment Scenario. The most likely scenario would be some combination of the two sediment sources. The B/C ratio for the sediment retention Alternative ranges from 0.7 using upland sediment to 1.2 using offshore sediment.

The matrix B/C ratios are listed in Table 18 below. The most likely Scenario will involve a combination of different sediment sources, so the B/C ratio for the regional program ranges from 0.5 to 1.2. The lowest B/C ratio is for Scenario 1A and the highest B/C ratio is for Scenario 4. If transport costs for upland sediment can be reduced, then the associated B/C ratios may increase and become larger than 1.0. The highest benefit/cost ratios are realized when offshore sediment is used, assuming inflation does not outpace interest rates into the future.

Table 18 - Annualized Costs and Benefits of RSM Alternatives

Alternative Scenario Units	**Annual Cost** $/YR	**Avg. Annual Nourishment Volume** CY/YR	**Benefit** $/YR	**B/C Ratio**
Scenario 1A - No Mgmt Devices, 1 M CY/YR, upland (0% fines), offshore sediment	$37,020,026	1,000,000	$18,740,321	0.5
Scenario 1B - No Mgmt Devices, 1 M CY/YR, upland (25% fines), offshore sediment	$30,455,257	1,000,000	$18,740,321	0.8
Scenario 2 - No Sediment Management Devices, 1 M CY/YR, offshore sediment	$18,211,709	1,000,000	$18,740,321	1.0
Scenario 3 – Sediment Management Devices, 500 K CY/YR, upland sediment	$25,968,700	500,000	$18,740,321	0.7
Scenario 4 – Sediment Management Devices, 500 K CY/YR, offshore sediment	$15,707,571	500,000	$18,740,321	1.2

8.4 Possible Funding Sources

A dedicated source of funding is highly desirable if the regional program is to be successful in its implementation. There are a number of possible local and regional sources to help cover the funding requirements of the two Alternatives. These include both existing and newly created funding sources. Existing possibilities for future funding include the state Ocean Protection Council, the State Coastal Conservancy, and the CCC mitigation funds that is currently administered by SANDAG. New potential funding sources include user fees such as rental car fees and parking fees at the beaches, as well as additional sales taxes, development impact fees, property tax assessments, and transient occupancy tax increases.

A more detailed analysis of potential funding sources should be conducted in the future to determine the optimum mixture of revenue streams and prepare a strategy for pursuit of those potential funding sources. The decision of whether or not to pursue funding sources through increased sales taxes or other issue-specific measures will depend on several factors, the most important of which will be the state of the economy and the prevailing political climate.

8.4.1
Regional Sales Tax

A regional sales tax could be used to provide a potential funding source to meet the regional sediment management needs of San Diego County. A regional sales tax would generate the greatest amount of flexibility and stability as the revenues would be controlled regionally and such funds would be better protected against inflation. The regional tax could be tied directly to regional sediment management needs (e.g., beach restoration) and/or regional needs.

8.4.2
Rental Car Fees

A fee could be levied on rental car leases within San Diego County to provide funding for regional sediment management activities. This fee could be levied on a cost per day basis (e.g., $0.25/day) or as a percentage of the rental price.

8.4.3
Transient Occupancy Tax

During the past two years, the SANDAG Shoreline Preservation Working Group has been discussing the use of a Transient Occupancy Tax (TOT) as a method for funding the region's beach sand replenishment program. A TOT would provide a reliable funding source based on the fact that TOTs have been implemented throughout the country with a great degree of success. Encinitas and Solana Beach currently levy a TOT and all the funds from that tax are dedicated to beach replenishment

8.4.4
Property Tax Assessments

Property tax assessments have been imposed by many cities and counties to help finance general obligation bonds for local flooding and storm-water management programs. This type of tax could be used to cover regional sediment management activities within San Diego County.

8.4.5
Parking Fees

A fee could be levied on beach parking within San Diego County coastal cities to provide funding for regional sediment management activities. This fee could be levied as an increase in existing parking fees where such fees exist, or as new parking fees in areas where no such fees exist. Implementing parking fees at city and state beaches would be difficult due to concerns about negative impacts on public access. Consequently, it might be better to levy parking fees only in non-beach areas (such as downtown or redevelopment districts) within coastal city jurisdictions.

8.4.6
Development Impact Fees

Development Impact Fees on residential, commercial, and industrial development could be considered to help fund regional sediment management needs. Studies could be prepared to demonstrate the impact new development has on sediment transport through coastal watersheds to the beaches in order to determine an appropriate cost sharing distribution.

8.4.7
Inland Sediment Transport Offset Fund

The recent development of opportunistic beach fill programs (e.g., SCOUPs I and II) throughout San Diego County represents the first step in facilitating sediment provision from inland sources to regional beaches. The next step is to implement these programs such that the beneficial reuse of suitable inland sediment on local beaches is considered a viable option for excavation projects within the coastal cities of San Diego County. The last step towards achieving this tangible goal is to provide economic incentives or funding for project proponents (e.g., coastal cities) and sediment suppliers (e.g., developers) to do the work. Funding or incentives are necessary because, in many cases, it will be more expensive for sediment suppliers to place suitable inland sediment on local beaches than it would be to use the material for other purposes such as fill or aggregate. Sediment suppliers may also find it more expensive to process and permit opportunistic beach fill projects in comparison to these other options. Consequently, funding or incentives are necessary to offset these additional costs, thereby making it financially viable for project proponents and sediment suppliers to place suitable inland sediment on local area beaches.

A matching fund could be set up to cover incremental costs associated with implementation of the opportunistic sand programs developed throughout coastal San Diego County. The matching fund could take many forms, and several options are identified below.

- **Option 1: State Fund – Full Incremental Cost Coverage**
  - Administration – California Department of Boating and Waterways
  - Funding – State bonds, supplemental taxes, and use fees
  - Uses – All incremental costs including planning, design, construction, and monitoring

- **Option 2: Regional Fund – Full Incremental Cost Coverage**
  - Administration – SANDAG
  - Funding – Regional bonds and supplemental taxes
  - Uses – All incremental costs including planning, design, construction, and monitoring

- **Option 3: Local Fund – Full Incremental Cost Coverage**
  - Administration – Coastal Cities
  - Funding – Municipal bonds and supplemental taxes
  - Uses – All incremental costs including planning, design, construction, and monitoring

- **Option 4: State Fund – Partial Incremental Cost Coverage**
  - Administration – California Department of Boating and Waterways
  - Funding – State bonds, supplemental taxes, and use fees
  - Uses – Incremental construction costs

- **Option 5: Regional Fund – Partial Incremental Cost Coverage**
  - Administration – SANDAG
  - Funding – Regional bonds and supplemental taxes
  - Uses – Incremental construction costs

- **Option 6: Local Fund – Partial Incremental Cost Coverage**
  - Administration – Coastal Cities
  - Funding – Municipal bonds and supplemental taxes
  - Uses – Incremental construction costs

The matching fund could utilize existing or new funding sources, including the potential funding sources identified in Sections 8.4.1 through 8.4.6. Alternatively, this fund could be an entirely new and separate funding source for regional sediment management. The coastal cities could impose a supplemental fee for the issuance of grading permits within their jurisdiction. If set aggressively enough (i.e., high fee) then this fee could be used as an incentive for project sediment suppliers to place suitable inland sediment on local beaches by making it more expensive to do otherwise. Alternatively, the fee could be set at low to modest levels to allow development to move forward without substantial cost increases while slowly and incrementally building the fund.

8.5 Permitting Requirements

Implementing the Coastal RSM Plan will require permits from the agencies listed below. Local agencies may require other permits not included in this list that should be inventoried. The most expeditious manner to implement the Coastal RSM Plan would be to secure general permits from all agencies as is described in more detail in the following section of this report.

- USACE – Either individual Sections 10, 106, and 404 permits or a Regional General Permit (RGP) for RSM projects in San Diego County. Issuance of these permits requires the USACE to consult with NOAA National Marine Fisheries Service and the U.S. Fish and Wildlife Service (USFWS) where necessary for Essential Fish Habitat (EFH) and Endangered Species Act issues, respectively. In the event a threatened or endangered species is present, a Section 7 Consultation would be required with the USFWS.
- California Coastal Commission – Coastal Development Permit (CDP) or Federal Consistency Determination.
- California State Lands Commission – Lease of State Lands for placement of sediment below the mean high tide line, which will include the requirement to perform a mean high tide line survey prior to the first placement and potentially re-survey every few years, if deemed necessary by the Commission as part of a long-term program.
- Regional Water Quality Control Board – Section 401 Certification for typical nourishment, and Waste Discharge Requirements (WDRs) under the State's Porter-Cologne Act and Clean Water Act if discharging fluidized dredge material (e.g., from a harbor, wetland, or lagoon).
- California State Department of Parks and Recreation – An Encroachment Permit will be required if the receiver site is located within a State Park or State Beach, or if access across state property is necessary for project implementation. This program could also require a special use permit or right of entry permit. The proponents will need to coordinate with California State Parks well in advance of beach nourishment activities.
- Local Agencies – A permit may be required from the local agency of the receiver site. This may include grading permit, Coastal Development Permit (CDP), special use permit, and variances to applicable ordinances. The Cities that could issue a CDP include Oceanside, Carlsbad, Encinitas, Del Mar, San Diego, Coronado, and Imperial Beach. Solana Beach may possess the authority to issue CDPs with an approved Local Coastal Program.
- California Department of Fish and Game – Potentially, a Streambed Alteration Agreement may be required if the receiver site is at or adjacent to an existing river mouth or streambed. Potentially, a California Endangered Species Act incidental take permit, 2081(b), if there is a likelihood of taking a state listed species.
- Compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) – The projects specified in the Plan must be consistent with CEQA and NEPA through environmental review. A joint Program CEQA/NEPA document could be required in the form of an Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS). More information about environmental review is provided in section 9.1.9 of this report.

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

8.6 Existing Permits

The USACE LA District Regulatory Branch is currently processing a number of 10-year permits at many of the potential receiver sites and sediment sources discussed above. Most of these permits are directly applicable to comprehensive sediment management as intended by the concept of regional sediment management. These permits and their status as of the time of Plan development include:

- Tijuana Estuary Sediment Fate and Transport Science Study – Permit previously issued and phase 1 of the project was constructed, monitoring results may affect 80-20 rule;
- City of Coronado Opportunistic Beach Fill Program - Permit still in processing;
- City of Imperial Beach Opportunistic. Beach Fill Program - Permit still in processing;
- City of Solana Beach Opportunistic. Beach Fill Program - Permit still in processing;
- City of Encinitas Opportunistic Beach Fill Program - Permit still in processing;
- City of Carlsbad Opportunistic Beach Fill Program – Permit previously issued and no work done yet;
- City of Oceanside Opportunistic. Beach Fill Program - Permit still in processing, public notice period occurring;
- San Dieguito River Inlet Dredging and Beach Nourishment Project – 10-year permit issued and some work done last year on each side of the inlet;
- San Elijo lagoon Inlet Dredging and Beach Nourishment Project – 10-year permit to be issued; and
- Los Penasquitos Inlet Dredging and Beach Nourishment Project – 10-year permit to be issued.

9.0

GOVERNANCE STRUCTURE AND IMPLEMENTATION

Implementation of this Coastal RSM Plan requires enforcement mechanisms and incentives. Without these mechanisms in place, sediment management will likely remain an ad-hoc activity, performed on a case-by-case basis without a long-term vision. A few possible mechanisms for governance are presented in this section.

9.1 Implementation Options for Governance Structure

Adoption of this Coastal RSM Plan by SANDAG is the first step towards ensuring that the Plan is consulted during sediment management activities throughout the San Diego region. SANDAG is best positioned to maintain the regional perspective needed to coordinate the various activities identified in this section and ensure that the Plan's goals and objectives are met.

Options for implementing this Coastal RSM Plan are included herein and specified below. The RSM projects require funding that may not presently be available but could potentially be obtained through economic incentives, bonds, legislation, or fees. A combination of multiple measures would increase the effectiveness of the Coastal RSM Plan.

9.1.1
Add to/Amend CEQA Initial Study Checklist

The California Environmental Quality Act (CEQA) requires each discretionary "project" in the state to be analyzed for potential environmental impacts. The Initial Study (IS) checklist is a screening document to help the reviewer determine which level of environmental review may be required by posing questions about potential impacts to resource areas. Each jurisdiction typically uses a standardized IS form, or the form provided by the state. Questions about whether the project will have an adverse impact or be consistent with coastal regional sediment management should be included in the CEQA IS to raise the issue for all projects. This would potentially require full disclosure of project inconsistencies with the Coastal RSM Plan and identify opportunities long before the project comes "on line." Mitigation measures, in the form of beach nourishment, or payment of an in-lieu fee could be identified for certain projects. Candidate projects could be proactively anticipated and incorporated into the sediment management effort, thereby increasing opportunities for nourishment.

The San Diego Chapter of the Association of Environmental Professionals (AEP) solicited member input on the local region's CEQA IS form in 2008, and SANDAG commented that questions should be added addressing the Coastal RSM Plan. The specific questions recommended for addition would inquire about whether the project may generate surplus sediment that could benefit the coast, and what specific data are available about the sediment. At

the time of adoption of this RSM Plan, the AEP had not yet concluded revision of the CEQA IS form. If the AEP does not revise the CEQA IS form, then the cities and County should consider amending the CEQA IS forms they use to incorporate RSM. This action is a highly feasible, and should not require any additional funding. State legislation may also be required to amend the CEQA IS form. However, local agencies could proceed with using a modified IS form in the near-term.

9.1.2
Rely on the California Coastal Act

The California Coastal Act (Coastal Act) is the law guiding operation of the California Coastal Commission. The present Coastal Commission policy is to require all projects within the coastal zone with surplus sandy sediment to place it at the coast. However projects often end up placing the sediment elsewhere for various reasons (e.g., limitations of timing, budget, and practical limitations). Amending the Coastal Act to more directly address regional sediment management is unlikely, so relying on the existing Act to guide policy is the practical alternative. The Coastal Act may be able to be relied upon to specifically require all projects within the coastal zone to consult this Coastal RSM Plan and identify why or why not the project is consistent with the Plan. It could also be an avenue to require that local agencies consult the Plan and initiate actions to secure approvals for use of receiver sites whenever possible. No additional funding or actions are required to apply the Coastal Act as described above.

9.1.3
Add to/Amend Local Coastal Programs

Existing Local Coastal Programs (LCPs) could be amended to require that project proponents consult the Coastal RSM Plan during conceptual project phases. This could be done when each LCP is renewed, and would probably require advisory input from the Coastal Commission. Actual sediment management activities are implemented most frequently at the local level, and local policy documents should specifically relay instructions of how to carry out the Coastal RSM Plan for individual projects. Amending LCPs is feasible, but would require funding for cities to perform the necessary planning tasks.

9.1.4
City/County Grading Permits

Local permits for construction could include requirements to implement sediment management activities if surplus sandy sediment is expected to be generated during project construction. To secure the permit, the local agency could require the applicant to consult the Coastal RSM Plan prior to formalizing their project, in order to either demonstrate consistency with the Plan or justify an exemption to the Plan. This action is feasible and no additional funding is required for this suggested action.

9.1.5
Incentives Through Reduced Developer Fees

Local agencies (cities and the County) impose fees on projects to issue permits. The local agencies gain revenue and fund staff time from this practice. If local agency financial conditions were suitable, the agency could either forego or reduce the fees imposed on applicants in exchange for an agreement to contribute the sandy sediment to either a stockpile or the coast. This economic incentive may either partially or entirely offset the incremental added costs for the developer to transport the material to the desired location. This action is feasible, depending on city economic conditions, and no additional funding is required for this recommended action.

9.1.6
Local Zoning Ordinances and General Plans

Local zoning ordinances and General Plan documents for both cities and the County could include provisions to require consultation of the Coastal RSM Plan. These ordinances could specify that the local agency identify and carry out actions called out in the Plan at the local level. The zoning ordinance is the main tool of enforcement available to a local agency. Modifying existing Zoning Ordinances and General Plans is feasible, but additional funding would be required.

9.1.7
Establish "Sandsheds/Littoral Cell" Planning Agencies

Establishment of "sandshed" (Revell et al. 2007) or littoral cell planning agencies that are analogous to watershed planning groups could further the initiatives of the Coastal RSM Plan. The closest resemblance to this type of group in the San Diego region is SANDAG's SPWG. The SPWG performs this function well at this point, but has to address a very broad range of coastal issues in addition to sediment management. The SPWG could therefore benefit from creation of a subgroup focused on sediment management within the sandsheds that carries information and recommendations forward to the SPWG. The feasibility of this action is in question, and additional funding would be required for its completion. Required steps would include SANDAG staff or members proposing formation of a sandshed planning agency to the SPWG, and a recommendation from the SPWG to the SANDAG Regional Planning Committee and Board of Directors.

9.1.8
General Permits

The USACE has issued Regional General Permit (RGP) #67 for opportunistic beach fill projects in Southern California. RGP 67 generally allows beach nourishment for projects that utilize at least 80 percent sandy sediment proven to be uncontaminated and proposed for placement below the mean higher high tide line. Requirements include a demonstrated need for the sediment at

the beach and a finding that sensitive environmental resources will not be impacted. The RGP 67 permit also was approved by the State Water Resources Control Board.

However, projects that lie outside of these parameters still require either individual permits or establishment of an opportunistic beach fill program. An opportunistic beach fill program was established in Carlsbad, and is being established as part of SCOUP I at Oceanside, and part of SCOUP II at Encinitas, Solana Beach, Coronado, and Imperial Beach. An opportunistic beach fill program results in general permits from all agencies, including the USACE, Regional Water Quality Control Board, California Coastal Commission, California State Parks, and State Lands Commission to place sediment on only designated local beaches if the material is at least 75 percent sand and clean of contaminants.

Approvals for implementing the Coastal RSM Plan would need to be made by all jurisdictional agencies. General permits should be secured for specific RSM Plan actions from jurisdictional agencies to allow elements of the plan to be carried out without the need for repeated permitting of each individual element. The permits should include elements of the Plan that are not already permitted (large-scale offshore dredging, sediment management devices, and nourishment), such that implementation can be streamlined for project construction. Permit periods could extend from 5 to 10 years, at which time permits would have to be extended or re-issued.

Establishing general permits is feasible, but would be challenging and require additional funding for planning tasks, agency applications, and staff processing time. Required steps would include:

1. Conducting a pre-application meeting with all agencies to present the concept;
2. Perform any outstanding technical studies or prepare technical documents identified as necessary from this RSM and from resource/permitting agency input including site investigations, monitoring plans, etc.
3. Prepare a draft CEQA/NEPA document;
4. Apply for permits to all jurisdictional agencies;
5. Respond to requests for additional information from permit agency staff;
6. Finalize the CEQA/NEPA document;
7. Attend hearings of permit agencies;
8. Complete all tasks required as part of permit conditions; and
9. Sign and file the permits.

Once individual projects are to occur, project-specific notifications, monitoring actions and reports will have to be completed and submitted to all permitting agencies to secure written concurrence to perform proposed actions. These project-specific actions will also require additional funds, but are feasible and required for any beach nourishment project.

9.1.9
Environmental Review

CEQA and NEPA have to be met to secure general permits for RSM Plan actions. The environmental review document could potentially be a combined Program Environmental Impact

Report/Environmental Impact Statement (PEIR/EIS) for the un-permitted components of the Plan involving offshore dredging, sediment management devices, and nourishment. However, the level of environmental review still needs to be determined. An appropriate regional or state entity may be most suitable to serve as CEQA Lead Agency, and the USACE (or another appropriate federal agency) could be the NEPA lead for the environmental document.

A program-level document would allow for evaluation of a suite of actions that would occur repeatedly over time through-out a defined future period, such as future modified RBSPs. As each future RBSP comes on-line, a supplemental EIR/EIS could be prepared to update the original programmatic document and to support updated or new permit applications. This approach is less costly and time-consuming as compared to preparing a new project-specific CEQA/NEPA document every 5 to 10 years.

This action is feasible and will require additional funding to complete. Next steps would be for SANDAG to discuss actions that could be the basis for the Project Description, and determine how best to coordinate the RSM Plan with the RBSP program. An initial vision may be to complete RBSP II and one pilot project for a sediment management device, and then proceed with a program-level RBSP project that includes the RSM elements of large-scale offshore dredging, sediment management devices, and nourishment.

9.1.10
Coordinate with State Regulatory Programs

There are several California regulatory efforts focused on planning measures directed at coastal resource protection that have the potential to limit the effectiveness of regional sediment management and implementation of the recommendations contained within this Coastal RSM Plan. SANDAG, CSMW and other stakeholders need to work with agency staff involved in these efforts to highlight needs and identify mutual goals and objectives so that all these important efforts can succeed. The following efforts are needed:

- The Marine Life Protection Act being implemented by the California Department of Fish and Game has the potential to inhibit dredging of offshore sources and placement of sediment or sediment management devices on the beach and nearshore. Designation of a Marine Protected Area where nourishment, placement of a sediment management device, or offshore dredging are proposed could severely limit the ability to conduct RSM (dependant on the type of MPA designated). CSMW and SANDAG have and should continue participating in the MLPA process to identify locations of future sediment management, and to share information on results of SANDAG monitoring (AMEC 2005, Coastal Frontiers 2008) and recent research on habitat benefits (e.g., SAIC 2005), and how nourishment can be conducted in an environmentally sensitive manner (e.g., SAIC, in review).

- Future Total Maximum Daily Load (TMDL) regulations for sediment being set by the Regional Water Quality Control Board (RWQCB) have the potential to further reduce delivery of beach-compatible sediment to the coast. SANDAG and the

CSMW are actively working with the State Water Resources Control Board and RWQCB staff and Directors to find ways to differentiate between coarse and fine sediment and to consider the impacts on sediment transport to the coast when developing TMDLs.

- Storm-water permits by the RWQCB requiring containment of all sediment on-site in detention basins at development projects also has the potential to reduce sediment delivery to the coast. SANDAG, CSMW and other stakeholders have and should continue to work with the SWRCB and RWQCB to find innovative ways to trap fine sediment on-site while allowing coarse, beach-compatible sediment to find its way to the coast.

9.2 Possible Challenges to Implementation

Challenges to the reuse of surplus sediments at eroding coastal areas exist that may be anticipated and accommodated. Challenges include certain federal policies, stakeholder interests, potential future regulations, existing economic disincentives, and practical project considerations. Examples of potential challenges to regional sediment management include those listed below. This is not an exhaustive list but more of a representative list of typical impediments within a region.

- **Policies** - USEPA uses a "rule-of-thumb" that the material placed at the coast should not exceed the percentage of fine-grained sediments at placement site by more than 10 percent, and that the material must be at least 80 percent sand and no more than 20 percent fines for nourishment, unless significant evidence is presented indicating a lack of adverse biological impacts. This step is costly and time-consuming to perform repeatedly for individual projects. CSMW and other stakeholders are working with USEPA to assess the impact of higher-percentage fine-grained sediment on water quality and biota through the Tijuana Estuary Sediment Fate and Transport Science Study. If the results of the study indicate that those materials can be used without adverse environmental impacts, USEPA will consider amendments to the 80/20 rule of thumb, most likely through a general permit approach.

- **Stakeholder Interests**
  - Concerns regarding adverse impacts to surfing and coastal resources;
  - Preventing impacts to local fisheries; and
  - Local citizen groups concerned about beach nourishment's potential adverse impacts on the environment, economics, and health and public safety.

- **Economic Disincentives**
  - Increased project costs and time required to secure permits for beach nourishment using upland material as part of a development proposal rather than disposing of it at an approved inland facility;
  - Increased costs to truck material to the coast from inland construction sites; and
  - Financial obligations associated with monitoring and possible mitigation.

- **Practical Project Considerations**
  - Existing constraints imposed on opportunistic beach fill projects (SCOUPs) for percentage of fines, timing of nourishment, and the rate of nourishment to minimize impacts on sensitive habitat areas;and
  - Monitoring and potential mitigation obligations and requirements.

These challenges may be avoided or proactively minimized to enable regional sediment management. A concentrated effort should be made to inform and coordinate with the various groups that might be opposed to activities specified within this the Coastal RSM Plan, or that are developing regulations that inadvertently or directly oppose regional sediment management. Education and information about regional sediment management should be shared with other groups to enable their objectives and needs to be met along with the needs of the coastal cities. Federal, state, and regional leaders will need to strike a balance amongst the interests of various stakeholder groups and the needs of the coast, and strive to maintain that balance as further development occurs throughout the region in the future if the quality of life committed to by SANDAG is to be preserved.

10.0

MONITORING AND REPORTING

Monitoring and reporting to assess performance and identify any environmental impacts to habitat, related potential mitigation, and suitable adaptive management measures will be required elements for all projects developed under the Coastal RSM Plan.

10.1 Impact Assessment and Performance Evaluation

Generally, a monitoring program may involve sediment sampling, beach profiles, surfing conditions, turbidity, and sensitive biota (Table 19). Monitoring elements would be dictated by project-specific features such as schedule or placement method. These monitoring requirements are based upon the SCOUP Plan (M&N 2006) and monitoring implemented during the RBSP I (AMEC 2002, 2005), and are consistent with the recommended measures to minimize impacts to biota and habitat contained in CSMWs draft Biological Impacts Analysis (SAIC, in review). The monitoring objectives focus on avoiding or minimizing adverse effects during project implementation and verifying that there are no significant adverse post-implementation effects. Costs for this monitoring need to be quantified.

Monitoring is also an effective feedback loop that provides a scientific basis for adaptive management decisions. This may be particularly relevant for documenting and tracking project performance to evaluate the success of sediment management in meeting shoreline protection and preservation objectives. It also assists in evaluating the effects of project designs or implementation strategies that substantially differ from previously permitted projects within the project area.

SANDAG and local cities presently implement a regional and local monitoring program that monitors the beach through regional profiling. They previously, performed more detailed physical and biological monitoring for RBSP I and compiled a nearshore habitat inventory. They will also perform similar monitoring during RBSP II. These efforts are all directly applicable and beneficial to implementation of this Coastal RSM Plan. Existing data should serve as the baseline for environmental review and permitting of the Plan.

Other monitoring efforts in the region include those of SIO as part of their MOP system for the Southern California Beach Processes Study, the City of Encinitas for local biological monitoring purposes, and by the USGS for the Tijuana Estuary Sediment Fate and Transport Science Study. These efforts all provide valuable information that can also be used to inform actions of the RSM Plan.

Table 19 - Overview of Monitoring Program

Project Phase	Type of Monitoring	Timing/Duration
Pre-project Baseline	Beach profiles	1 month prior
	Surf conditions	1/2 month prior, 3 times per week over 14 days
	Grunion habitat suitability (if surf zone or berm placement) Grunion monitoring (if habitat suitable)	Prior to construction, coordinate with resource and regulatory agencies if project is scheduled between March 1 and August 31 regarding appropriate protective measures (including monitoring). Monitor 2 to 3 weeks prior to construction before or during predicted grunion run closest to project initiation if habitat suitable
	Nearshore sensitive resources (if applicable); e.g., Pismo clam beds, giant kelp beds, surfgrass beds, nearshore reefs with sea fans, sea palms, or feather boa kelp	30 days prior to project start
During Construction	Turbidity	Daily during construction
	Grunion monitoring	If scheduled between March 1 and August 31 (monitoring frequency dictated by tides and lunar cycle, approximately every 2 weeks during spawning season)
	Endangered and Threatened Species Western snowy plover (e.g., monitoring if receiver site is within critical habitat, adjacent to known breeding sites, or within known wintering areas);	Prior to construction, coordinate with resource and regulatory agencies regarding appropriate protective measures (including monitoring) and need for Section 7 consultation if project is within or may affect critical habitat, scheduled between March 1 and September 30 within 1,500 ft of nesting sites, or between September 30 and February 28 within known wintering areas.
	California least tern (e.g., monitoring of turbidity outside surf zone if receiver site is near known breeding sites)	Prior to construction, coordinate with resource and regulatory agencies regarding appropriate protective measures (including monitoring) and need for Section 7 consultation if project is scheduled between April 1 and August 30
Post-Construction	Beach profiles	Immediately after completion
	Surf conditions	1 month after, 3 times per week over 14 days
	Nearshore sensitive resources (if appropriate)	90 days after construction
Post-Project	Beach profiles	Over 1 year following construction; surveys at 6 months after and 1 year after
	Nearshore sensitive resources (if appropriate)	Approximately 1 year following construction or as appropriate with concurrence of permitting agencies
Years 1 (pre-project), 2, 3, and 5	Beach Sand Gradation Nearshore Sand Gradation (conduct grain size sampling and testing over time at receiver site beaches to confirm sediment gradation remains natural over time)	Summer

Source: SCOUP Plan, 2006; EDAW 2008; SAIC, in review.

Note: Costs of these actions still need to be quantified.

10.2 Adaptive Management

The Coastal RSM Plan is a "living document" that will require periodic updates to add or modify actions. The Coastal RSM Plan will be updated using a collaborative process between SANDAG, municipalities and resource and regulatory agencies. The update will consist of review of the continued applicability of sediment management strategies, modifications to activities based on lessons learned, and potential additional actions, as appropriate. A decision will be made at the time of the review as to whether sufficient modifications are recommended to warrant a formal update of the Plan. Revisions to the Plan would be made available for review by the public.

11.0

DATA GAPS AND RECOMMENDED NEXT STEPS

Data gaps exist that need to be addressed prior to implementing the Plan. Development of this Coastal RSM Plan focused on collecting all known and available relevant data and analyses. New data should be collected and new analyses performed to inform decision-makers involved with the sediment management effort. These new data and analyses are listed below. Next, the regional and local governments will need to take a series of steps toward implementing the Plan throughout the region. Those steps are also presented below.

11.1 Data Gaps and Needed Analyses

Data gaps have been identified through research of existing available data. It is necessary to fill these data gaps prior to Plan implementation. The most obvious gaps identified thus far include:

- Sediment gradation data for all remaining Coastal RSM Plan beaches - beaches already characterized include South Oceanside, Batiquitos Beach (Encinitas), Moonlight Beach, Fletcher Cove, Coronado, Imperial Beach, and the beach at Border Field Park State. These data are required to establish the grain size envelope for receiver beaches for any permit; and
- More complete and updated on- and off-shore sediment source information throughout the region as a standardized data set to be referenced for possible nourishment opportunities.

Additional analyses that are also needed include:

- Completed evaluation of the longshore sediment transport data by the SIO CDIP program to determine appropriate proportional placement scenarios for lagoon maintenance;
- Integrate the mini-subcell analysis being done by SIO into this Coastal RSM Plan;
- Estimate environmental habitat benefits in dollars for future benefit/cost analyses required for state grant funding;
- Evaluate actual project performance and compare results to model predictions to improve those models for future use;
- Quantify the risk to sensitive reef areas from sedimentation, relative to sediment placement volume or frequency;
- Assess the effect of sediment management devices on reducing future nourishment quantities and shortening the time-frame needed to add 30 million cubic yards to the region;
- Determine effects of sediment management devices on biological and physical environments; and
- Continue to evaluate potential offshore sources of sediment through multi-beam bathymetry (backscatter) and seismic reflection/refraction profiling such as that being

pursued in the area by USGS and SIO researchers, and as performed by SANDAG for RBSPs I and II.

11.2 Recommended Next Steps – Short- and Long-Term

A series of short- and long-term steps are listed below that SANDAG will need to coordinate in order to carry out the plan.

§ **Short-Term Steps (2 to 5 Years)**

1. Continue educating the public on the need for regional sediment management.
2. Work with local agency staff to explain how the Coastal RSM Plan can benefit them and the San Diego region, and develop strategies for them to integrate it within their jurisdictional authorities.
3. Implement immediate short-term Coastal RSM Plan measures such as:
   a. Identify whether the receiver sites proposed within this Plan are acceptable, and revise relevant aspects of previous SANDAG RBSP sites;
   b. Confirm interest in and locations for sediment management devices;
   c. Acquire sediment gradation data for receiver sites not sampled since 2005;
   d. Update the list of possible sediment sources including location, quantity, and frequency of availability;
   e. Determine effectiveness of sediment management devices through numerical and physical modeling; and
   f. Update possible stockpile locations.
4. Update the Shoreline Preservation Strategy to include new information from the RBSPs and advances in science and technology.
5. Work with the RWQCB to promote transport of sediment to the coast when considering TMDLs and sediment detention basins.
6. Work within the MLPA initiative process to ensure that modified and/or new MPAs reflect the region's need for sediment management.
7. Coordinate with watershed managers to facilitate continued coastal sediment yield.

§ **Long-Term Steps (5 to 10 Years)**

1. Prepare a program CEQA/NEPA document for certain specific actions of the Plan, such as large-scale offshore dredging, implementation sediment management devices, and nourishment.
2. Establish an appropriate "sandshed/littoral cell" authority to coordinate sediment availability and include them within the SPWG.
3. Conduct a feasibility study for installing railroad off-loading sites where appropriate as part of any double-tracking project to facilitate transport by rail.

4. Develop a regional sediment monitoring program extend from the existing SANDAG program to achieve more comprehensive and efficient implementation and adaptation of projects within the Coastal RSM Plan program including:
    a. Lagoon sedimentation for maintenance dredging;
    b. Waves and longshore sediment transport;
    c. River discharge;
    d. Accretion and erosion along the coast using beach profiles;
    e. Sedimentation at nearshore reefs; and
    f. Effects on surfing.
5. Integrate longshore sediment transport estimates from the SIO CDIP program into the living document data base, considering lagoon mini-subcells as hypothesized by O'Reilly (2008).
6. Develop a systematic approach to local agency implementation when projects are applied for, with City staff or the sandshed/littoral cell authority performing the initial evaluation for candidacy.
7. Establish one or several general permits from all agencies for all sites (including new sites and nearshore placement sites) that may include amending the USEPA's 80/20 rule-of-thumb.
8. Implement action steps for each City such as:
    a. Identify opportunistic sand during project processing;
    b. Identify funding sources (or incentives) to implement opportunistic projects;
    c. Perform opportunistic beach fill projects (and monitoring);
    d. Amend LCPs and General Plans as needed to be consistent with the Coastal RSM Plan;
    e. Install any needed infrastructure to enable sand delivery (e.g., ramps to the beach).
9. Implement action steps by SANDAG such as:
    a. Install sediment management devices;
    b. Optimize implementation of the Coastal RSM Plan based on monitoring results; and
    c. Identify the grain sizes best suited for certain sites (e.g., coarse sediment for Fletcher Cove) after monitoring results are assessed.
10. Link watershed and sediment management planning to:
    a. Leverage federal and state funding; and
    b. Provide incentives to the private sector through reduced fees.
11. Create a secure funding stream by establishing a funding strategy.
12. Impose fees on dam owners who impound sediment and document local efforts as matches.
13. Utilize data from pilot projects, such as the Tijuana Estuary Sediment Fate and Transport Science Study, to update the San Diego CRSM Plan.

12.0

CONCLUSIONS

The following conclusions result from development of this San Diego Coastal Regional Sediment Management Plan:

1. **Sediment Management**

   Regional sediment management is needed in the San Diego region to address a severe sediment deficit through coordination of multiple separate efforts and to realize sediment placement quantity targets that would restore the region's coastal sediment supply. This Coastal RSM Plan provides a framework to solve the problem of insufficient sediment being delivered to the coast.

2. **Surplus Sediment**

   Surplus sediment exists upland, at lagoons and harbors, and at offshore locations that could be beneficially reused to address the San Diego region's sediment deficit.

3. **Critical Erosion Areas**

   Critical areas of coastal erosion exist throughout the region, from Oceanside to Imperial Beach, and have been identified as potential receiver sites within this Coastal RSM Plan.

4. **Methods to Counter Erosion**

   The Plan's goal is regional nourishment of the coast with sufficient sediment to overcome existing sediment losses through an additional 30 million cubic yards within 50 years. Methods to counter erosion include facilitating sediment delivery from upland, placing sediments from maintenance dredging at beaches while considering net longshore transport rates and patterns, dredging sediment from offshore, and bypassing sediment from upcoast of Oceanside Harbor. Coordination by SANDAG and the USACE for offshore sediment projects must continue to occur.

5. **Sediment Placement Quantities**

   To reach the 50-year target, one million cubic yards per year of sediment will need to be added to the coast if sediment management devices are not utilized. Sediment sources can include both upland and offshore sediment, or be composed of only offshore sediment.

   The recommended quantity of sediment to be added to the coast is 500,000 cubic yards per year, assuming sediment management devices are used to retain as much of the sediment for as long as possible. This option, along with proportional placement of

sediment from lagoons and harbors and bypassing of sediment from upcoast of Oceanside Harbor, is the preferred concept for this Coastal RSM Plan

7. **Economics**

Project economics for offshore sediment appear favorable, with a B/C ratio of 1.0 without sediment management devices, while the use of upland materials does not appear to be favorable as the B/C ratio is lower than 1.0. Projects should focus on using offshore sediment until a cost reduction for use of upland sediment can be realized. Use of sediment management devices increases the B/C ratio to 1.2 and reduces long-term costs by 25 percent compared to non-retention.

8. **Governance**

Various measures may be available to provide an incentive to implement recommendations in this Coastal RSM Plan including: integrating consistency with the Coastal RSM Plan as part of CEQA, the California Coastal Act, Local Coastal Plans, and City/County Grading Permits; reducing developer fees; integrating the plan into Local Zoning Ordinances and General Plans; setting up "Sandshed" Planning Agencies; and securing general permits.

9. **Challenges to the Plan**

Challenges to successful implementation of the Plan include certain agency policies, stakeholder interests, economic disincentives, and practical considerations of moving upland sediment to the beach. Impedances can be addressed through proactive education, coordination, planning, and activism to anticipate issues and address them through the planning process. Two processes are perceived to represent major challenges to beach nourishment as a regional sediment management tool. The Marine Life Protection Act, could potentially restrict nourishment and offshore dredging sufficiently to render sediment management ineffective in specified areas. Also, development of TMDLs for sediment in the San Diego Region by the RWQCB could significantly restrict further delivery of sediment to the coast, although SANDAG recognizes that TMDLs are a necessary water quality improvement approach.

10. **Monitoring and Reporting**

Existing and planned SANDAG monitoring efforts, the CSMWs draft recommendations for minimizing adverse biological impacts (SAIC, in progress), and monitoring by SIO and others can be integrated to provide adequate monitoring and reporting of biology, beach profiles, and lagoon shoaling. Monitoring results will be incorporated into the Plan to optimize the Plan and improve its effectiveness.

11. **Data Gaps**

Many data gaps exist that need to be filled with regard to source and receiver site sediment data, quantified environmental benefits of projects, verification of coastal and habitat models, and longshore transport data verification.

12. Next Steps

Next steps include short- and long-term actions to bring the plan to life by initiating plan recommendations and performing nourishment as appropriate. Those steps are summarized in Section 11.2 of this Plan.

13.0

REFERENCES

Alpine Ocean Seismic Survey, Inc. 2008. Final Report. Vibracore Sampling, San Diego Regional Beach Sand Project II. December 1, 2008.

Ambrose, R.F., D.C. Reed, J.M. Engle, and M.F. Caswell. 1989. California Comprehensive Offshore Resource Study. Submitted to: State Lands Commission. Sacramento, California.

AMEC Earth & Environmental, Inc. (AMEC). 2002. Regional Beach Sand Project Preconstruction and Construction Monitoring Report. Prepared for San Diego Association of Governments.

AMEC. 2005. Regional Beach Sand Project, Year 4 (2004-2005) Post-construction Monitoring Report for Intertidal, Shallow Subtidal, and Kelp Forest Resources and Comprehensive Analysis Report (2001-2005). Prepared for San Diego Association of Governments. Available at: <http://www.sandag.org/index.asp?subclassid=32& fuseaction= home.subclasshome>.

Atwood, J., J. Fancher and L. Feeney. 1994. California Least Tern *in* C.G. Thelander ed. Life on the Edge A Guide to California's Endangered Natural Resources Biosystems Books: 184-187.

Atwood, J.L. and D.E. Minsky. 1983. Least Tern Foraging Ecology at Three Major California Breeding Colonies. *Western Birds* 14: 57-72.

Bruce, C., K. Miller, G. Page, L. Stenzel, and W. White. 1994. Western Snowy Plover. Pages 180-182 In *Life on the Edge: A Guide to California's Endangered Natural Resources*. C.G. Thelander (ed.). Biosystems Books:

Burke, M.K., W.C. Dennison, and K.A. Moore. 1996. Non-structural carbohydrate reserves of eelgrass *Zostera marina*. *Marine Ecology Progress Series*, 137:195-201.

CalFlora. 2006. Information on California plants for education, research and conservation. [web application]. 2005. Berkeley, California: The Calflora Database [a non-profit organization]. Available: <http://www.calflora.org/>, Accessed February 2006.

California Coastal Commission (CCC). 1987. *California Coastal Resource Guide*. University of California Press, Berkeley.

California Data Information Program. 2008. Center for Coastal Studies. Scripps Institute of Oceanography. URL: <http://cdip.ucsd.edu/>.

California State Coastal Conservancy (Coastal Conservancy) and the San Diego Association of Governments (SANDAG). 2008. San Diego Nearshore Program: Inventory and Evaluation of Habitats and Other Environmental Resources in San Diego Region's Nearshore Coastal Zone. URL: <http://nearshore.ucsd.edu/>, accessed 2008.

CNPS (California Native Plant Society). 1996. Policy on Invasive Exotic Plants. URL: <http://www.cnps.org/archives/exotics.htm>, Accessed August 2005.

Coastal Environments. 2001. Feasibility Study and Conceptual Plan for Relocation of the San Elijo Lagoon Inlet. Prepared for The City of Encinitas, Engineering Services Department, 28 February 2001.

Coastal Frontiers Corporation. 2004. 2004 Regional Beach Monitoring Program, Annual Report. Prepared for San Diego Association of Governments (SANDAG). Available at: <http://www.sandag.org/index.asp?subclassid=32&fuseaction =home.subclass home>.

_____. 2008. SANDAG 2007 Regional Beach Monitoring Report, Annual Report. April 2008.

_____. 2008. Personal Communication with Greg Hearon and Moffatt & Nichol, May 20, 2008.

Coastal Sediment Management Workgroup. 2008. Draft California Beach Restoration Survey. August 2008.

Collins, C.T., K.E. Bender, and D.D. Rypka. 1979. Report on the Feeding and Nesting Habits of the California Least Tern in the Santa Ana River Marsh Area, Orange County, California. Prepared for the U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

Cross, J.N. and L.G. Allen. 1993. Fishes. Pages 459 to 540 Pages 369-458 in: *Ecology of the Southern California Bight: A Synthesis and Interpretation.* M.D. Dailey, D.J. Reish, and J.W. Anderson (eds.). University of California Press, Berkeley, California.

CZR, Inc. 2003. Waterbird and Shorebird Use at Ocean Isle Beach in Brunswick County, North Carolina, December 2001-November 2002. Prepared for U.S. Army Corps of Engineers, Wilmington District, Wilmington, DE.

Department of Boating and Waterways. 1998. The Fate of Fine Sediments in a Suspension Plume: Ponto Beach, California. April 1998.

Department of Boating and Waterways and San Diego Association of Governments. 1994. Shoreline Erosion Assessment and Atlas of the San Diego Region, Volumes I and II. December 1994.

Department of Boating and Waterways and State Coastal conservancy. 2002. California Beach Restoration Study. January 2002

Diaz, R.J., G.R. Cutter, Jr., and C.H. Hobbs, III. 2004. Potential impacts of sand mining offshore of Maryland and Delaware: Part 2 – Biological Considerations. *Journal of Coastal Research*, 20(1):61-69.

EDAW. 2006. Final Mitigated Negative Declaration, Sand Compatibility and Opportunistic Use Program (SCOUP) Pilot Project Site in the City of Oceanside. November 2006.

_____. 2008. Final Mitigated Negative Declaration for the Opportunistic Beach Fill Program in the Cities of Encinitas, Solana Beach, Coronado, and Imperial Beach. April 2008.

Everest International Consultants, Inc. 2008. Coastal Sediment Analysis Tool (CSBAT – San Diego): Sediment Management Decision Support Tool for San Diego County, Technical Report. Prepared for U.S. Army Corps of Engineers Los Angeles District, Los Angeles, CA, December 2008.

Everts Coastal. 2002. Guides to Evaluate the Effectiveness of Offshore Beach Retention Structures at Encinitas, California. May 24, 2002.

Fritzsche, R.A., R.H. Chamberlain, and R.A. Fischer. 1985. California Grunion. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest). Biological Report 82(11.28), TR EL-82-4.

Fugro. 2008. Seismic Survey. Beach Replenishment, San Diego, California. October 9, 2008.

Gibbs, R.E. 1902. *Phyllospadix* as a beach builder. *American Naturalist*, 36:101-109.

Greene, K. 2002. Beach Nourishment: A Review of the Biological and Physical Impacts. ASMFC Habitat Management Series #7. Atlantic States Marine Fisheries Commission.

Gregory, P.A. 2001. Grunion. Pages 246-247, In: *California Department of Fish and Game California's Living Marine Resources: A Status Report*.

Griem, J.N. and K.M. Martin. 2000. Wave action: the environmental trigger for hatching in the California grunion *Leuresthes tenuis* (Teleostei: Atherinopsidae). *Marine Biology*, 137:177-181.

Habel, J.S. and G.A. Armstrong. 1978. Assessment and atlas of shoreline erosion along the California coast. State of California Department of Boating and Waterways, Sacramento, CA, 277p.

Hearon, Greg. 2008. Personal Communication with Chris Webb on May 20, 2008.

Hirsch, N.D., L.H. DiSalvo, and R. Peddicord. 1978. Effects of Dredging and Disposal on Aquatic Organisms. Technical Report DS-78-5, U.S. Army Engineer Waterways Experiment Station, Environmental Laboratory, Vicksburg, Mississippi.

Hoffman, R.S. 1986. Fishery Utilization of Eelgrass (*Zostera marina*) Beds and Non-Vegetated Shallow Water Areas in San Diego Bay. Southwest Region, National Marine Fisheries Service, NOAA, Administrative Report SWR-86-4.

Hogarth, L.J., et al. 2007. Long-term tectonic control on Holocene shelf sedimentation offshore La Jolla, CA. *Geology*, March 2007, V35, Number 3, p. 275-278.

Hurme, A.K. and E. Pullen. 1988. Biological effects of marine sand mining and fill placement for beach replenishment: Lessons for other uses. *Marine Mining*, 7:123-136.

Inman, D.L. and J.D. Frautschy. 1966. Littoral processes and the development of shorelines. *Proceedings Coastal Engineering Specialty Conf*erence ASCE, p. 511-536.

IPCC. 2007. *Climate Change 2007: The Physical Science Basis.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon S., et al. (eds.). Cambridge University Press. Available at <http:// www.ipcc.ch/>.

Jutte, P.C., R.F. Van Dolah, and P.T. Gayes. 2002. Recovery of benthic communities following offshore dredging, Myrtle Beach, South Carolina. *Shore & Beach*, 70(3): 25-30.

Lafferty, K.D. 2000. Status, Trends and Conservation of the Western Snowy Plover with a Focus on the Devereux Slough Population at Coal Oil Point Reserve, Santa Barbara County, CA. Museum of Systematics and Ecology Environmental Report No. 15, University of California, Santa Barbara.

_____. 2001. Disturbance to wintering western snowy plovers. *Biodiversity and Conservation*, 101:315-325.

LaSalle, M., D.G. Clarke, J. Homziak, J.D. Lunz, and T.J. Fredette. 1991. A Framework for Assessing the Need for Seasonal Restrictions on Dredging and Disposal Operations. Technical Report D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Littler, M.M., D.R. Martz, and D.S. Littler. 1983. Effects of recurrent sand deposition on rocky intertidal organisms: Importance of substrate heterogeneity in a fluctuating environment. *Mar. Ecol. Prog. Ser*. 11: 129-139.

Love, M. 1996. *Probably More Than You Want to Know About the Fishes of the Pacific Coast.* Really Big Press.

Martin, Karen. 2009. Personal Communication to Loni Adams, California Department of Fish and Game. February 2009.

Martin, K. 1999. Ready and waiting: delayed hatching and extended incubation of anamniotic vertebrate terrestrial eggs. *American Zoologist*, 39:279-288.

_____. 2006. Introduction to Grunion Biology. Available at: <http://arachnid. pepperdine.edu/grunion/default.htm>.

Martin, K.L. and D.L. Swiederski. 2001. Beach spawning in fishes: phlylogenetic tests of hypotheses. *American Zoologist*, 41:526-537.

MEC. 2000. Appendix D to the SANDAG Regional Beach Sand Project EIR/EA. Evaluation of Impacts to Marine Resources and Water Quality from Dredging of Sands from Offshore Borrow Sites and Beach Replenishment at Oceanside, Carlsbad, Leucadia, Encinitas, Cardiff, Solana Beach, Del Mar, Torrey Pines, Mission Beach, and Imperial Beach, California. Prepared for KEA Environmental, Inc.

Melvin, S. M., C.R. Griffin, and L.H. MacIvor. 2001. Recovery strategies for piping plovers in managed coastal landscapes. *Coastal Management*, 19:21-34.

Miller, K.J., D. Buford, and H. Mossman. 1999. Designation of Critical Habitat for the Pacific Coast Population of the Western Snowy Plover - Final Rule. Federal Register Vol. 64 No. 234: 68507-68544.

Moffatt & Nichol Engineers. 1988. Historic Wave and Sea Level Data Report, San Diego Region. Coast of California Storm and Tidal Waves Study. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA, December 1988.

_____. 1995. Oceanside Harbor Impact Study. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA. 1995.

_____. 2000a. San Diego County Shoreline Technical Report. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA. May 15, 2000.

_____. 2000b. Final Report Shoreline Morphology Study San Diego Regional Beach Sand Project. Appendix C of the Environmental Impact Report/Review of Environmental Assessment, March 2000.

_____. 2000c. Carlsbad Opportunistic Beach Fill Program and Concept Design. February 2000.

_____. 2001. Regional Beach Sand Retention Strategy. October 2001.

Moffatt & Nichol. 2006. Final Sand Compatibility and Opportunistic Use Program Plan. Prepared for SANDAG and the Coastal Sediment Management Workgroup, February 2006.

_____. 2008. Unpublished data of sediment grain size sampling and analyses done for SCOUP II sites at Imperial Beach, Coronado, Solana Beach, and Encinitas.

National Oceanic and Atmospheric Administration (NOAA). 2001. *Guide to the Seagrasses of the United States of America (Including U.S. Territories in the Caribbean).* Available on U.S. National Oceanic and Atmospheric Administration, Coastal Services Center, *Submerged Aquatic Vegetation: Data Development and Applied Uses,* (CD-ROM), (NOAA/CSC/20116-CD), Charleston, SC.

Naqvi, S.M. and E.J. Pullen. 1982. Effects of Beach Nourishment and Borrowing on Marine Organisms. Prepared for U.S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, VA.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. *Oceanography and Marine Biology: An Annual Review,* 36:127-178.

Noble Consultants. 2000. Additional Marine Geophysical Survey Work. San Diego Regional Beach Sand Project. October 18, 2000.

Nordby, Chris. 2008. Personal Communication with Moffatt & Nichol, September 15, 2008.

NRC. 1995. *Beach Nourishment and Protection*. National Academy Press, Washington, D.C. 334 pp.

O'Reilly, William. 2008. Personal Communication with Moffatt & Nichol, May 20, 2008.

_____. 2008. Wave-driven Littoral Subcells in the Southern California Bight. *Eos Trans. AGU, 89(53),* Fall Meeting Suppl., Abstract OS34A-02.

Orth, R.J., M. Luchenback, and K.A. Moore. 1994. Seed dispersal in a marine macrophyte: Implications for colonization and restoration. *Ecology,* 75(7):1927-1939.

Orth, R.J., M.L. Luchenback, S.R. Marion, K.A. Moore, and D.J. Wilcox. 2006. Seagrass recovery in the Delmarva Coastal Bays, USA. *Aquatic Botany,* 84(1):26-36.

Patsch, K. and G. Griggs. 2006. Littoral Cells, Sand Budgets, and Beaches: Understanding California's Shoreline. University of California, Santa Cruz, Institute of Marine Sciences, prepared for the California Department of Boating and Waterways and the California Coastal Sediment Management Workgroup, October 2006.

Peterson, C.H. and M.J. Bishop. 2005. Assessing the environmental impacts of beach nourishment. *BioScience*, 55(10):857-896.

Peterson, C.H., L.M. Manning, J.S. Taylor, G.A. Johnson. 2002. How Beach Nourishment Affects the Habitat Value of Intertidal Beach Prey for Surf Fish and Shorebirds and Why Uncertainty Still Exists. PowerPoint Presentation, April 2002 presentation to North Carolina Division of Coastal Management. Available at: <http://dcm2.enr.state.nc.us/sitemap.htm>, accessed March 2006.

Phillips, R.C. 1984. The Ecology of Eelgrass Meadows in the Pacific Northwest: A Community Profile. U.S. Fish and Wildlife Service, FWS/OBS-84/24. 85 pp.

Rakocinski, C.F., R.W. Heard, S.E. LeCroy, J.A. McLelland, and T. Simons. 1996. Responses of Macrobenthos Assemblages to Extensive Beach Restoration at Perdido Key, Florida. *Journal of Coastal Research*, 12(1):326-353.

Reed, D.C. and S.J Hollbrook. 2003. An experimental evaluation of methods of surfgrass (*Phyllospadix torreyi*) restoration using early life history stages. Final Technical Summary, Final Study Report. Prepared for U.S. Department of the Interior Minerals Management Service Pacific OCS Region under MMS Cooperative Agreement No. 14-35-0001-30758.

Reilly, F.J, Jr. and V.J. Bellis. 1983. The Ecological Impact of Beach Nourishment with Dredged Materials on the Intertidal Zone at Bogue Banks, North Carolina. Prepared for U.S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, VA.

Revell, D.L., J.J. Marra, and G.B. Griggs. 2007. Sandshed Management. *Journal of Coastal Research*, SI 50 (Proceedings of the 9th International Coastal Symposium), 93-98, Goldcoast, Australia, ISSN 0749.0208.

Science Applications International Corporation. 2005. Coastal Habitat Study, 2003-2004: Influence of Beach Nourishment on Biological Resources at the Beaches at Encinitas, California. Science Applications International Corporation, January 2005.

_____. 2006. Coastal Habitat Study, 2003-2005: Influence of Beach Nourishment on Biological Resources at Beaches in the City of Encinitas, California. Prepared for City of Encinitas, Science Applications International Corporation, 2006.

_____. 2009. Coastal Habitat Survey of Onshore and Nearshore Beach Receiver Sites Proposed in the Coastal Regional Sediment Management Plan, San Diego. Prepared for Moffatt & Nichol under contract to the U.S. Army Corps of Engineers, Los Angeles District.

_____. *in review*. Draft Review of Biological Impacts Associated with Sediment Management and Protection of California Coastal Biota in Support of the California Sediment Management Master Plan. Prepared for the California Coastal Sediment Management Workgroup under contract to the Beach Erosion Authority for Clean Oceans and Nourishment (BEACON), March 2007.

San Diego Association of Governments. 1993. Shoreline Preservation Strategy for the San Diego Region. July 1993.

_____. 2004. Regional Comprehensive Plan for the San Diego Region. July 2004.

_____. 2007a. Internal Documentation, Cost Analyses of Sand Nourishment Scenarios for the Regional Comprehensive Plan.

_____. 2007b. Feasibility Study. San Diego Regional Beach Sand Replenishment Project. August 2007.

Sea Surveyor. 1999. San Diego Regional Beach Sand Project, Offshore Sand Investigations. April 1999.

Seymour, R. 2008. Personal Communication with Moffatt & Nichol on May 20, 2008.

Slagel, M. and G.B. Griggs. 2006. Cumulative Losses of Sand to the California Coast by Dam Impoundment. Institute of Marine Sciences, University of California, Santa Cruz, May 2006.

Smyder, E.A. and K.L.M. Martin. 2002. Temperature effects on egg survival and hatching during the extended incubation period of California grunion, *Leuresthes tenuis*. *Copeia*, 2:313-320.

Sherman, D.J., B.H. Jones, E.J. Farrell, J. Wang, and Z. Zheng. 1998. *The Fate of Fine Sediments in a Suspension Plume: Ponto Beach, California, A Report of Findings.* University of Southern California, Department of Geography, Geomorphology Research Report Number 4, April 1998.

Thompson, J.R. 1973. Ecological Effects of Offshore Dredging and Beach Nourishment: A Review. MP 1-73, U.S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, Virginia.

U.S. Army Corps of Engineers. 1984. Sediment Samples Dana Point to Mexican Border (Task ID, Nov. 83 to Jan. 84). Coast of California Storm and Tidal Waves Study CCSTWS84S, U.S. Army Corps of Engineers Los Angeles District, Los Angeles, CA.

_____. 1990. Coast of California Storm and Tidal Wave Study. Sediment Budget Report Oceanside Littoral Cell. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, November 1990.

_____. 1991a. State of the Coast Report San Diego Region, Volume I Main Report, Final, Coast of California Storm and Tidal Waves Study. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

_____. 1991b. State of the Coast Report San Diego Region, Volume II Appendices, Final, Coast of California Storm and Tidal Waves Study. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

_____. 2003. Morro Bay Estuary City of Morro Bay, San Luis Obispo County, CA Ecosystem Restoration Feasibility Study, F3 Conference Report Without-Project Conditions Analysis. Prepared July 2003.

_____. 2006. Regional General Permit Number 67, Discharges of Dredged or Upland Derived Fill Materials for Beach Nourishment. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA, September 25, 2006.

U.S. Fish and Wildlife Service (USFWS). 2000. Biological Opinion on San Diego Regional Beaches Sand Replenishment Project, Coastal Zone of San Diego County, California. FWS Log No. 1-6-01-F-1046; Corps Public Notice No. 1999-15076-RLK.

Versar, Inc. 2004. Year 2 Recovery from Impacts of Beach Nourishment of Surfzone and Nearshore Fish and Benthic Resources on Bald Head Island, Caswell Beach, Oak Island, and Holden Beach, North Carolina. Final Study Findings, for the U.S. Army Corps of Engineers, Wilmington District, Wilmington, DE.

Ware, R. 1993. Eelgrass (*Zostera marina*) in southern California bays and wetlands with emphasis on Orange County, California. *Shore and Beach*, 20-30.

Williams, S. 1995. Surfgrass (*Phyllospadix torreyi*) reproduction: reproductive phenology, resource allocation, and male rarity. *Ecology*, 76(6):1953-1970.

Woodward-Clyde Consultants. 1998. Letter Report to American Waste Management. April 1998.

Wright, T.D., D.B. Mathis, and J.M. Brannon. 1978. Aquatic Disposal Field Investigations, Galveston, Texas, Offshore Disposal Site; Evaluative Summary. Technical Report D-77-20, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Zimmerman, R.C., J.L. Reguzzoni, and R.S. Alberte. 1995. Eelgrass (*Zostera marina* L.) transplants in San Francisco Bay; role of light availability on metabolism, growth and survival. *Aquatic Botany*, 51:67-86.

APPENDIX A

OTHER RELEVANT COASTAL REFERENCES AND SEDIMENT INFORMATION

Task A.1. Relevant Coastal References

Task A1. Scope of Work

Compile Relevant coastal references and sediment information – the M&N Team will compile references used to summarize information on coastal resources (including sensitive biological resources and other data) in the vicinity of proposed sand receiver sites, and sediment information of receiver sites and sources. Work done for the SCOUP will significantly apply to this task.

Applegate. June. 1985. Buena Vista Lagoon and Watershed Sediment Control Study. Prepared for the San Diego Region's Nearshore Coastal Zone. Prepared by Merkel & Associates. Prepared for California State Coastal Conservancy and SANDAG. February 20, 2004 .

Carotta, John. 2008. Coastal Reference database in Microsoft Access. California Department of Conservation. Available at www.dbw.ca.gov/csmw/default.aspx

Carotta, John. 2008. CRSMIS, a georeferenced database of GIS layers and shape files in ArcGIS 9. California Department of Conservation, Available at www.dbw.ca.gov/csmw/default.aspxCity of Solana Beach. 1999. Solana Beach General Plan Beach & Bluff Element. March 1999.

Coastal Environments. 1997. Sand for Trash Demonstration Project. La Paz County Landfill. September 1997.

———. 2000. Buena Vista Lagoon Land Management Plan Elements Lagoon Bathymetry, Water Quality, Biological Analysis, and Soils Analysis. December 2000.

———. 2001. Feasibility Study and Conceptual Plan for Relocation of the San Elijo Lagoon Inlet. Prepared for The City of Encinitas, Engineering Services Department, 28 February 2001.

Coastal Frontiers Corporation. 2007. SANDAG 2006 Regional Beach Monitoring Program Annual Report. Prepared for SANDAG. April 2007. Similar titles for years 2001, 2002, 2003, 2004, and 2005.

CSMW a. (California Coastal Sediment Management Workgroup) Table3Task3CSMS.xls references used to compile the listing of known beach nourishment projects and performance in California. http://www.dbw.ca.gov/csmw/PDF/TABLE3TASK3CSMW.pdf. And http://www.dbw.ca.gov/csmw/nourishment_needs.htm.

——— b. (California Coastal Sediment Management Workgroup), Additional 140 references in the bibliography of "Results from the CSMS Task1 (Coastal Erosion – Needs for Beach Nourishment)" at http://www.dbw.ca.gov/csmw/PDF/Results_From_CSMW_Task1.pdf.

——— c. (California Coastal Sediment Management Workgroup), Coastal Erosion & Beach Nourishment Needs, http://www.dbw.ca.gov/csmw/PDF/TABLE1TASK1CSMW.pdf. Table 1. "Selected Sites of Important Coastal Erosion in California.",

Department of Boating and Waterways. 2002. California Beach Restoration Study. State Coastal Conservancy, January 2002.

———. 1998. The Fate of Fine Sediments in a Suspension Plume: Ponto Beach, California. April 1998.

Department of Boating and Waterways and San Diego Association of Governments. 1994. Shoreline Erosion Assessment and Atlas of the San Diego Region, Volumes I and II. December 1994.

Department of Navigation and Ocean Development. 1977. Assessment and Atlas of Shoreline Erosion Along the California Coast. State of California – The Resources Agency. July 1977.

Everest. 2006. The ArcGIS Coastal Sediment Analyst (CSA) A Prototype Decision Support Tool for Regional Sediment Management (RSM) Program Whitepaper. Prepared by Everest International Consultants, Inc., for the US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, April 2006.

Everts Coastal. 2002. Guides to Evaluate the Effectiveness of Offshore Beach Retention Structures at Encinitas, California. California Department of Boating and Waterways, May 2002.

Griggs, G. and K. Patsch. 2006. Littoral Cells, Sand Budgets, and Beaches: Understanding California's Shoreline. University of California, Santa Cruz, Institute of Marine Sciences, prepared for the California Department of Boating and Waterways and the California Coastal Sediment Management Workgroup, October 2006.

———. 2007. Development of Sand Budgets for California's Major Littoral Cells Eureka, Santa Cruz, Southern Monterey Bay, Santa Barbara, Santa Monica (including Zuma), San Pedro, Laguna, Oceanside, Mission Bay, and Silver Strand Littoral Cells. University of California, Santa Cruz, Institute of Marine Sciences, prepared for the California Department of Boating and Waterways and the California Coastal Sediment Management Workgroup, January 2007.

Griggs, G. and M. Slagel. 2006. Cumulative Losses of Sand to the California Coast by Dam Impoundment. University of California, Santa Cruz, Institute of Marine Sciences, prepared for the California Coastal Sediment Management Workgroup and the California Department of Boating and Waterways, May 2006.

Hogarth, L., Babcock, J. Driscoll, N., *et. al.* 2007. Long-term Tectonic Control on Holocene Shelf Sedimentation Offshore La Jolla, California. Scripps Institute of Oceanography, *Geological Society of America*, March 2007; v.35; no.3; p. 275-278.

King, P. 2001. Overcrowding and the Demand for Beaches in California. Prepared for the California Department of Boating and Waterways, April 2001.

———. 2006. The Economics of Regional Sediment Management in Ventura and Santa Barbara Counties: A Pilot Study. ww.dbw.ca.gov/csmw/csmwhome/library.htm, February 2006.

King, P. and D. Symes. 2003. The Potential Loss in Gross National Product and Gross State Product from a Failure to Maintain California's Beaches. Report prepared for the California Department of Boating and Waterways. http://userwww.sfsu.edu/~pgking/pubpol.htm and the Southern California Beach Project Report on Expenditures, http://marineeconomics.noaa.gov/SCBeach/laobeach1.html#reports

Leeworthy, V.R., *et. al.* 2007. Southern California Beach Recreation Valuation Project: Summary. Found at http://www.marineeconomics.noaa.gov/SCBeach/laobeach1.html, June 2007.

MEC Analytical. 2000. Appendix D to the SANDAG Regional Beach Sand Project EIR/EA. Evaluation of Impacts to Marine Resources and Water Quality from Dredging of Sands from Offshore Borrow Sites and Beach Replenishment at Oceanside, Carlsbad, Leucadia, Encinitas, Cardiff, Solana Beach, Del Mar, Torrey Pines, Mission Beach, and Imperial Beach, California. March 2000.

Merkel & Associates. 2001. Long-term Biological Monitoring and Pilot Vegetation Program for the Batiquitos Lagoon Enhancement Project.

———. 2004. Inventory and Evaluation of Habitats and other Environmental Resources in the San Diego Region's Nearshore Coastal Zone.

Moffatt & Nichol Engineers. 1996. Technical Report for City of Encinitas Comprehensive Coastal Bluff and Shoreline Plan Addressing Coastal Bluff Recession and Shoreline Erosion. February 1996.

———. 1998. Revised Final Technical Report Opportunistic Beach Fill Criteria and Concept Design. Prepared for City of Carlsbad, Carlsbad Opportunistic Beach Fill Program, June 1998.

———. 2000a. Final Report Shoreline Morphology Study San Diego Regional Beach Sand Project. Constitutes Appendix C of the Environmental Impact Report/Review of Environmental Assessment, March 2000.

———. 2000b. Carlsbad Opportunistic Beach Fill Program and Concept Design. February 2000.

Moffatt & Nichol. 2006. Final Sand Compatibility and Opportunistic Use Program Plan. Prepared for SANDAG, February 2006. www.dbw.ca.gov/csmw/csmwhome/library.htm

Moffatt and Nichol, and Everts Coastal. 2008. Regional Sediment Management – Offshore Canyon Sand Capture. Final Position Paper Report (90%), January 2008.

National Ocean Service. 2003. La Jolla, CA Bench Mark Data Sheets. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, http://tidesandcurrents.noaa.gov/, April 21, 2003.

Noble, R. 2002. Beach Nourishment Construction at Twelve San Diego County, California Receiver Beach Sites. *World Dredging Mining & Construction*, February 2002.

Research Planning, Inc. 1995. Sensitivity of Coastal Environments and Wildlife to Spilled Oil – Southern California Atlas. Prepared for California Department of Fish and Game, Office of Oil Spill Prevention and Response and NOAA, Hazardous Materials Response and Assessment Division, Maps SC 1-10, March 1995.

San Diego Association of Governments. 1993. Shoreline Preservation Strategy for the San Diego Region. July 1993.

———. 1992. Preliminary Technical Report, Evaluation of Coastal Erosion Problems in the Mission Bay Littoral Cell (Ocean, Pacific, and Mission Beaches) San Diego Region. November 5, 1992.

———. 2000. San Diego Regional Beach Sand Project EIR/EIS. June 2000.

USACE. 1962. Beach Erosion Control Report on Cooperative Study of Coast of Southern California, Point Conception to Mexican Boundary, Appendix VII, 2nd Interim Report. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

———. 1978. Imperial Beach Erosion Control Project San Diego County, California. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, April 1978.

———. 1987a. Oceanside Littoral Cell Preliminary Sediment Budget Report, Coast of California Storm and Tidal Waves Study. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, December 1987.

———. 1987b. Silver Strand Littoral Cell Preliminary Sediment Budget, Coast of California Storm and Tidal Waves Study. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, December 1987.

———. 1988. Sediment Budget Report Mission Bay Littoral Cell. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, December 1988.

———. 1990a. Coast of California Storm and Tidal Wave Study. Sediment Budget Report Oceanside Littoral Cell. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, November 1990.

———. 1990b. Sediment Budget Report Oceanside Littoral Cell, Coast of California Storm and tidal Waves Study. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, November 1990.

———. 1991a. State of the Coast Report San Diego Region, Volume I Main Report, Final, Coast of California Storm and Tidal Waves Study. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

———. 1991b. State of the Coast Report San Diego Region, Volume II Appendices, Final, Coast of California Storm and Tidal Waves Study. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

———. 2000. San Diego County Shoreline Technical Report. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, May 5, 2000.

———. 2002a. Silver Strand Shoreline Imperial Beach, California, General Reevaluation Report, Appendix B, Coastal Engineering. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, October 2002.

———. 2002b. Coast of California Storm and Tidal Waves Study South Coast Region, Orange County. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, December 2002.

———. 2003a. Coastal Engineering Manual Volume V: Coastal Project Planning and Design. Prepared by the US Army Corps of Engineers, Coastal & Hydraulics Laboratory and ERDC USACE, Vicksburg, MS.

———. 2003b. Draft Without-Project Conditions Economic Analysis, Encinitas and Solana Beach Shoreline Feasibility Study. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, September 2003.

———. 2004a. Economic Guidance Memorandum: Unit day values for Recreation, Fiscal Year 2004, http://www.usace.army.mil/civilworks/cecwp/General_guidance/egm04-03.pdf.

———. 2004b. Encinitas and Solana Beach Shoreline San Diego County, California, Draft Geotechnical Report, Feasibiltiy Phase Evaluation, F-4 (with project conditions). US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, July 2, 2004.

———. 2004c. Mission Bay Entrance Channel Maintenance Dredging, San Diego County, California, Geotechnical Report. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, April 23, 2004.

———. 2005. Encinitas and Solana Beach Shoreline Feasibility Study San Diego County, California, Draft Feasibility Report. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, August 2005.

———. 2006. Regional General Permit Number 67, Discharges of Dredged or Upland Derived Fill Materials for Beach Nourishment. US Army Corps of Engineers, Los Angeles District, Los Angeles, CA, September 25, 2006.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. 1998. Inland Testing Manual (ITM) Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual. EPA Reference 823-B-98-004, February 1998.

U.S. Department of the Navy. 1995. Final Environmental Impact Statement for the Development of Facilities in San Diego / Coronado to Support the Homeporting of One NIMITZ Class Aircraft Carrier. November 1995.

Wilson J. P., D.W. Goldberg, and C.S.Lam. 2004. The ArcGIS Coastal Sediment Analyst: A Prototype Decision Support Tool for Regional Sediment Management. Los Angeles, California: University of Southern California GIS Research Laboratory, Technical Report No. 3, July 2004.

Young, A.P. and S.A. Ashford. 2006. Application of Airborne LIDAR for Seacliff Volumetric Change and Beach-Sediment contributions. *Journal of Coastal Research*, 22(2), pp 307-31.

APPENDIX B

PUBLIC WORKSHOP ATTENDANCE LISTS AND CONTACT INFORMATION

SANDAG

SIGN-IN SHEET

San Diego Regional Sediment Management Workshop

January 23, 2008

YOU ARE NOT REQUIRED TO SIGN-IN, however, if you would like SANDAG staff to know that you attended this meeting and want to provide a method of contacting you, please fill in the information below. Please note that SANDAG's sign-in sheets are public records and may be disclosed to the public upon request.

NAME	ADDRESS	PHONE NUMBER	EMAIL ADDRESS	Add To List?
Kevin Wood	401 B St, SD, CA 92101	619-699-7312	kw@sandag.org	✓
Susan Steele	1300 Neptune	760 632 8649	STEELE.SUSAN@ATT.NET	
Don Connors	921 Begonia Ct Cbad	760 931-0200	primussystems@earthlink.net	✓
Vince Balch	1540 Hubbs Dr Oside	760 435-4031	vbalch@ci.oceanside.ca.us	✓
Teresa Barth	505 S Vulcan Ave	760-733-2620	tbarth@ci.encinitas.ca.us	✓
Karen Green	SAIC	858 826-4939	greenka@saic.com	
Bob Hoffman	501 Ocean Long Bch	562-590-4043	bob.hoffman@oceq.gov	
Mark Rauscher	PO Box 6010 San Clad 92674	949-492-8170	mrauscher@surfrider.org	✓
NICK BUHBE	AMEC SAN DIEGO	858-300-4321	nicholas.buhbe@amec.com	✓
RAY DUNCAN	301 N THELMA OCEANSIDE CA 92054	760 435-9014	RDUNCAN@ci.oceanside.ca.us	✓
Sara Agahi	County of SD 5201 Ruffin Rd, SD	858-694-2265	sara.agahi@sdcounty.ca.gov	✓
Carrie Downey	319 D Ave Coronado	619-522-2090	CADOWNEY@SANDIEGO.COM	✓
Leslea Meyerhoff	Solana Beach	760/845-8028	LMeyerhoff@cosb.org	✓
JAMES SMITH	SWEETWATER AUTHORITY		JSMITH@SWEETWATER.ORG	
Lilian Busse	9174 Sky Park Court, SD 92123	858-467-2971	lbusse@waterboards.ca.gov	✓
David Moore	2433 Impala Dr.	760-795-6956	David.Moore@weatherstation.com	✓
Matt Wertman	2433 Impala Dr	760-803-1559	Matt.Wertman@WertmanSolutions.com	✓
Karen Brindley	1 Civic Center Dr, SM	760 744 1050 x3220	Kbrindley@ci.san-marcos.ca.us	✓
PAUL VO	" "	" " x3215	PVO@ci.san-marcos.ca.us	✓
Paul Jacob	201 C St MS35	619-235-5242	PJacob@sandiego.gov	✓
Ronnie Chan	4477 Pacific Hwy SD 92101	619-688-3260		
NAME	ADDRESS	PHONE NUMBER	EMAIL ADDRESS	Add To
Darren Smith	"	619 278-3785	darrens@parks.ca.gov	

				List?
Cristen Mendoza	4216 Florida St. AAB	831-917-8552	mendozacm@tisl.edu	
Jim Gonsalves	1600 Pacific Hwy	619-531-5133	J.m.gonsalves@sdcounty.ca.gov	
LINDA FLOURNOY	Planning & Engineering for Sustainability		sustainableworld1@earthlink.net (ON?)	
John Swanson	PLANNING City of Coronado	619 522 7326	JSwanson@coronado.ca.us	✓
Barry Lindgren	San Elijo Lagoon Conservancy		barry@sanelijo.org	
James Bond	6055 Vulcan Ave, Encinitas	760-633-2623	JBOND@EL.EncinitasCA.US	
STEVE ACETI	1133 2nd ST. ENC.	760-612-3564	STEVEACETIE@CALCOAST.ORG	
GREG WADE	825 IMPERIAL BEACH BL.	619-628-1354	gwade@cityofib.org	
Loni Adams	4949 Viewridge Rd S.D., CA	858-627-3985	ladams@DFG.ca.gov	
Lisa Wood	9601 Ridgehaven Ct SD CA 92123	858 573-1236	LFWood@sandiego.gov	✓
PATRICK MILLER	2660 DEL MAR HTS RD #301 SDCA	858 755-5446	PTMCRC@GMAIL.COM	
Grace Chung	SANDAG		gchu@sandag.org	
JOHN HUDDY	2531 Avenida Dia S.D. 92101	619-235-5914	Jhuddy@sandiego.gov	
BILL BRIGGS	3165 Kurtis St SD 92106	619-686-6284	wbriggs@portofsandiego.org	
Michele Okihiro	9500 Gilman Dr #0209 La Jolla, CA 92109	(858) 273-8284	mokihiro@ucsd.edu	✓
Chris Webb	MAN	562-426-9557	cwebb@[illegible]hotmail.com	✓
David Cannon	444 W. Ocean Long Beach CA	562-435-9309		✓

SANDAG

SIGN-IN SHEET

File Number 3002800

Coastal Regional Sediment Management Plan
Environmental Issue Workshop
April 3, 2008

YOU ARE NOT REQUIRED TO SIGN-IN, however, if you would like SANDAG staff to know that you attended this meeting and want to provide a method of contacting you, please fill in the information below. Please note that SANDAG's sign-in sheets are public records and may be disclosed to the public upon request.

NAME	ADDRESS	PHONE NUMBER	EMAIL ADDRESS
Karen Green	SAIC	858-826-4939	greenkm@saic.com
Bob Ho Etman	NMFS	562-980-4093	bob.ho[illegible]
Lori Adams	CDFG-	858-627-3985	ladams@dfg.ca.g[illegible]
Andrea Groves	SANDAG	619-699-1983	agr@sandag.org
Clif Davenport	CSMW	707 576-2986	clif.davenport@conservation.ca.gov
Robt Smith	ACOE	8386746784	robert.r.smith@usace.army.mil
Heather Schisler	USACE	213-452-3810	heather.r.schisler@usace.army.mil
Chris Webb	Moffatt & Nichol	562-426-9551	cwebb@moffattnichol.com
Shelby Tucker			
Kevin WOOD			

CSMW ATTENDEES

Name	Organization	Phone	E-mail
George Domurat	USACE - Division	415-503-6575	George.W.Domurat@usace.army.mil
Caleb Conn	USACE – SF	415-503-6849	Caleb.B.Conn@usace.army.mil
Heather Schlosser	USACE - LA	213-452-3810	Heather.R.Schlosser@usace.army.mil
Marriah Abellera	USACE - LA	213-452-3835	Marriah.S.Abellera@usace.army.mil
Maya Dehner	USACE – LA	213-452-3832	Maya.E.Dehner@usace.army.mil
Sam Johnson	USGS	831-427-4746	sjohnson@usgs.gov
Syd Brown	State Parks	916-653-9930	sbrow@parks.ca.gov
Clif Davenport	CGS	707-576-2986	Clif.Davenport@conservation.ca.gov
Kim Sterrett	DBW	916-263-8157	sterrett@dbw.ca.gov
Mark Johnson	Coastal Commission	415-904-5245	mjohnsson@coastal.ca.gov
Chris Potter	CA Resources	916-654-0536	chris.potter@resources.ca.gov
Cat Kuhlman	EPA/ Regional Water Board	707-696-7180	ckuhlman@waterboards.ca.gov
Megan Johnson	Coastal Conservancy		mjohnson@scc.ca.gov
Bill O'Reilly	SIO / CDIP		woreilly@ucsd.edu
Bob Guza	SIO / CDIP		rguza@ucsd.edu
Dick Seymour	SIO / CDIP		rseymour@ucsd.edu
Julie Thomas	SIO / CDIP	858-534-3034	jot@splash.ucsd.edu
Michele Okihiro	SIO		mokihiro@ucsd.edu
Reinhard Flick	SIO / CDBW		rflick@ucsd.edu
Mark Rauscher	Surfrider Foundation		mrauscher@surfrider.org
Steve Aceti	CA Coastal Coalition		steveaceti@calcoast.org

Andrea Groves	SANDAG		agr@sandag.org
Kevin Wood	SANDAG		kwo@sandag.org
Chris Webb	Moffatt & Nichol	562-426-9551	cwebb@moffatnichol.com
Karen Green	SAIC		greenka@saic.com
Jim Haussener	CMANC	925-828-6215	jim@cmanc.com

SANDAG

Coastal Regional Sediment Management Plan
June 5, 2008 City of Encinitas

SIGN IN

Phone	Name	AFFILIATION or Resident	City of Residence	e-mail (Optional)
✓	Chris Webb	Moffatt & Nichol	Long Beach	cwebb@moffattnichol.com
✓	Karen Green	SAIC	Oceanside	greenka@saic.com
✓	John C. Swanson	City of Coronado	San Diego	
858 637 5581	Chris Means	SD Regional Water Board	La Mesa	cmeans@waterboards.ca.gov
	[illegible]			
858-467-2968	Benjamin James	SD Regional Water Board	San Diego	bjames@waterboards.ca.gov
✓	Sara Aghai	County of San Diego		sara.aghai@sdcounty.ca.gov
✓	Michele Okihiro	Scripps - CDIP	San Diego	mokihiro@ucsd.edu
✓	JAMES BOND	CITY OF ENCINITAS		SBOND@CI.ENCINITAS.CA.US
✓	Kevin WOOD	SANDAG		KWO@sandag.org
✓	Kathy Weldon	Encinitas		Kweldon@ci.encinitas.ca.us

SANDAG

Coastal Regional Sediment Management Plan
June 5, 2008 City of Encinitas

SIGN IN

Phone	Name	AFFILIATION or Resident	City of Residence	e-mail (Optional)
✓	Chris Webb	Moffatt & Nichol	Long Beach	cwebb@moffattnichol.com
✓	Karen Green	SAIC	Oceanside	greenke@saic.com
✓	John C. Swanson	City of Coronado	San Diego	
858637558	Chris Means	SD Regional Water Board	La Mesa	cmeans@waterboards.ca.gov
[redacted]				
858-467-2968	Benjamin James	SD Regional Water Board	San Diego	bjamse@waterboards.ca.gov
✓	Sarah Aghali	County of San Diego		sara.aghali@sdcounty.ca.gov
✓	Michele Okihiro	Scripps - CDIP	San Diego	mokihiro@ucsd.edu
✓	JAMES BOND	CITY OF ENCINITAS		JBOND@CI.ENCINITAS.CA.US
✓	Kevin WOOD	SANDAG		KWO@sandag.org
✓	Kathy Weldon	Encinitas		Kweldon@ci.encinitas.ca.us

SANDAG

SIGN-IN SHEET

File Number 3002801

Coastal Regional Sediment Management Plan
Public Workshop – Imperial Beach
June 12, 2008

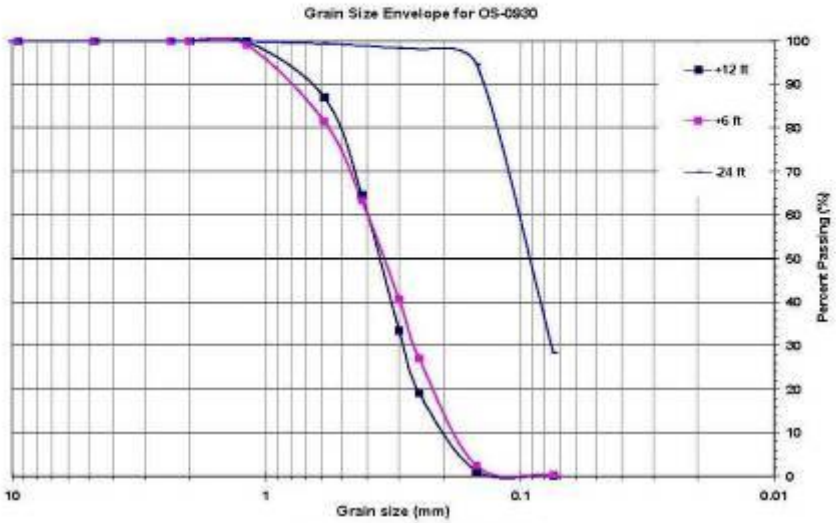
YOU ARE NOT REQUIRED TO SIGN-IN, however, if you would like SANDAG staff to know that you attended this meeting and want to provide a method of contacting you, please fill in the information below. Please note that SANDAG's sign-in sheets are public records and may be disclosed to the public upon request.

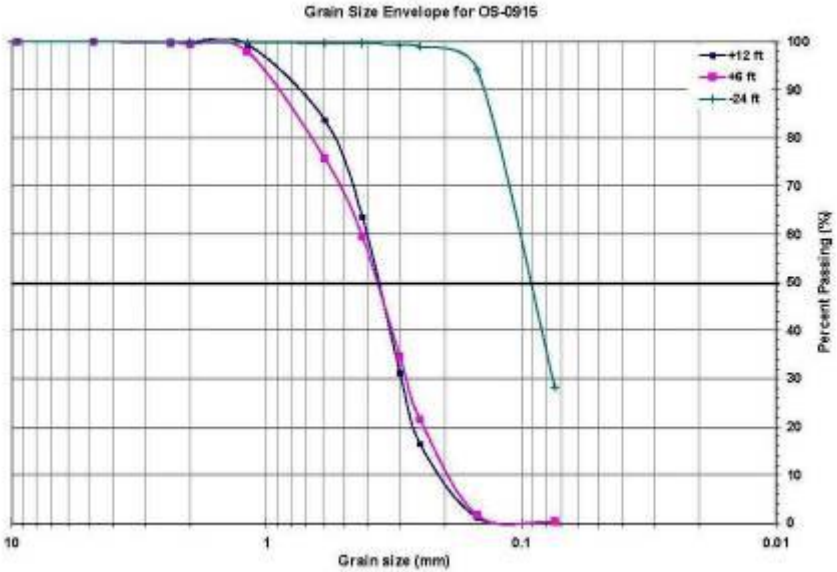
NAME	Affiliation	ADDRESS	PHONE NUMBER	EMAIL ADDRES
Kevin Wood	Sandag	401 B St		
Karen Green	SAIC			greenka@saic.com
Jim Nakagawa	City of Imperial Beach		628-1355	jnakagawa@cityofib.org
Serge Dedina	Wildcoast		619.423.8665	sdedina@wildcoast
Jeff Knox	Tijuana Sloughs Surf Club	753 Iris Ave IB	619-423-3989	mechist@sdcoe.net k12.ca.us
GREG WADE	CITY OF I.B.	825 I.B. BLVD. 91932	619-628-1354	gwade@cityofib.org
Roger Benham	IB Resident	220 Dahlia Ave, IB, CA 91932	619-424-6257	roger@ibcentro.com
Chris Webb	Moffatt & Nichol	3780 Kilroy Airport Way Long Beach CA 90806	562-426-9551	cwebb@moffattnichol.com
Andrea Groves	SANDAG	401 B St.	619-699-1983	agr@sandag.org
Ray Duncan City of Oceanside		301 N. The Strand Oceanside 92054	760435-4014	rduncan@ci.oceanside.ca.us
Clif Davenport	CSMW	135 Ridgeway Santa Rosa	7075762986	clif.davenport@conservation.ca.gov
Alfonso López	1271 Florence St. I.B. CA. 91932		619-227-9040	TRCC.ALF
JAY NOVAK	I.B. Resident	195 ELDER I.B. 91932	619 429-6363	@GMAIL.COM novacksoft@
Heather Schlosser	Corps of Eng.	915 Wilshire Blvd. Los Angeles	213-452-3810	heather.r.schlosser@usace.army.mil
Fred McLean	I.B. City Council, 825 I.B. Blvd, I.B.		(619) 433-8303	fredmclean@cox.net
Patricia Hagg	City Council member " "		423-0495	raccoon4ib@aol.
MAYDA WINTER	CITY COUNCILMEMBER - IMPERIAL BEACH		619-424-7303	winter4ib@aol.com
Gary Brown	City of IB, City Mgr	825 IB Blvd	619-423-0314	gbrown@cityofib.org

APPENDIX C

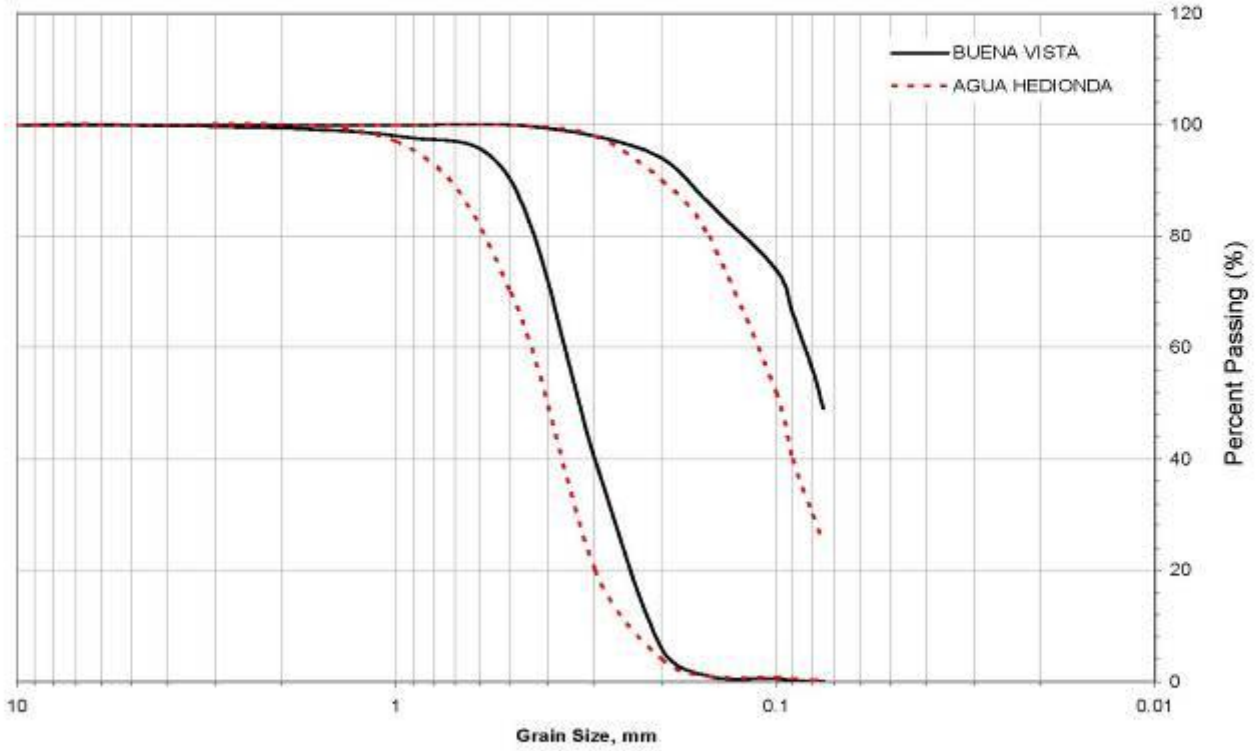
SAND GRADATION CURVES FOR SAN DIEGO REGION BEACHES

Existing Sand Gradation Curves for South Oceanside

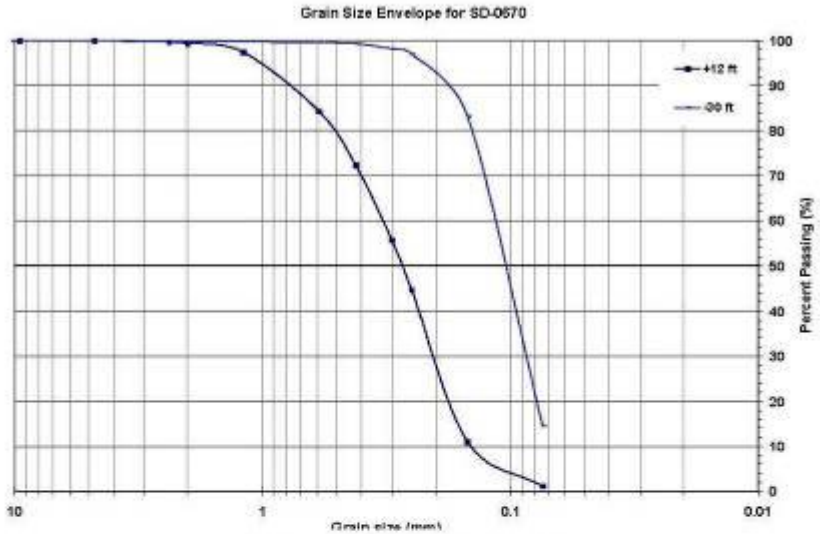


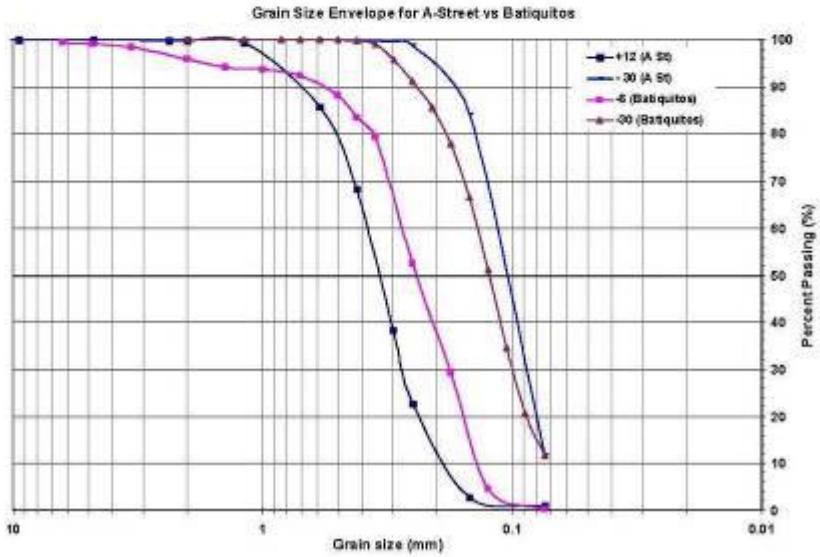


Existing Sand Gradation Curves for Carlsbad

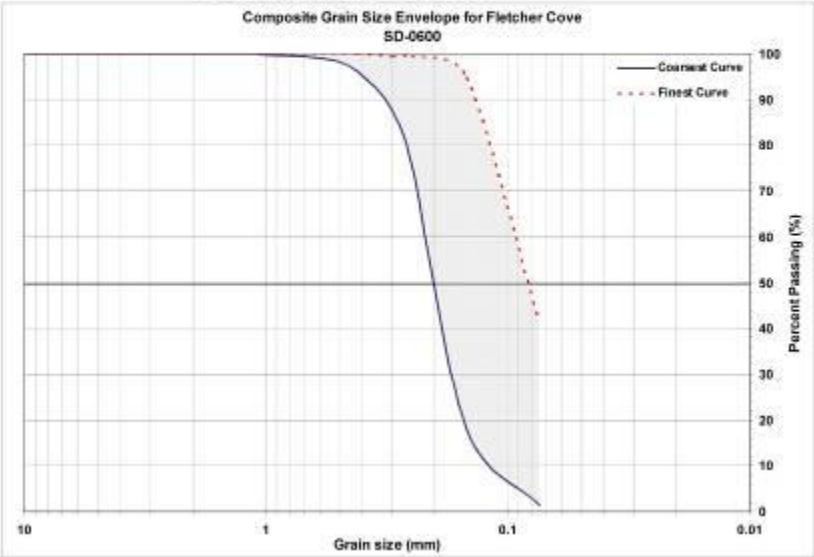


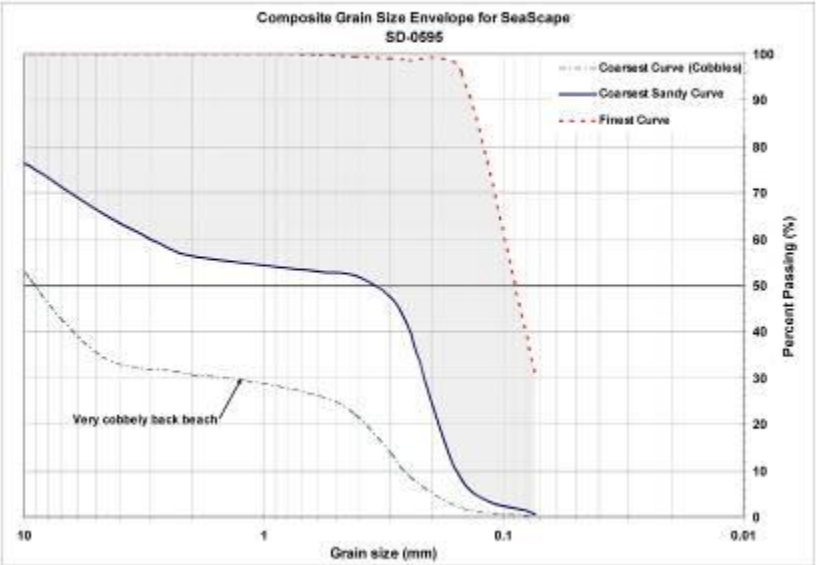
Existing Sand Gradation Curves for Encinitas



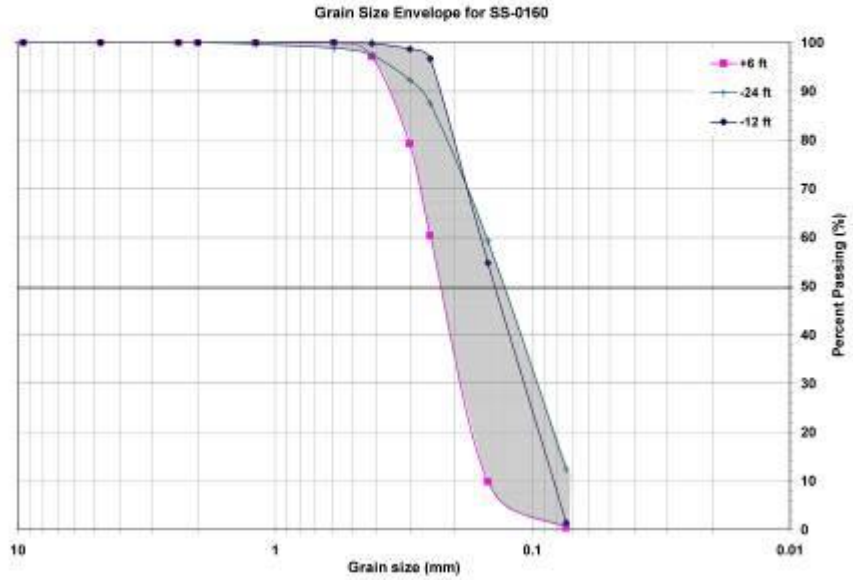


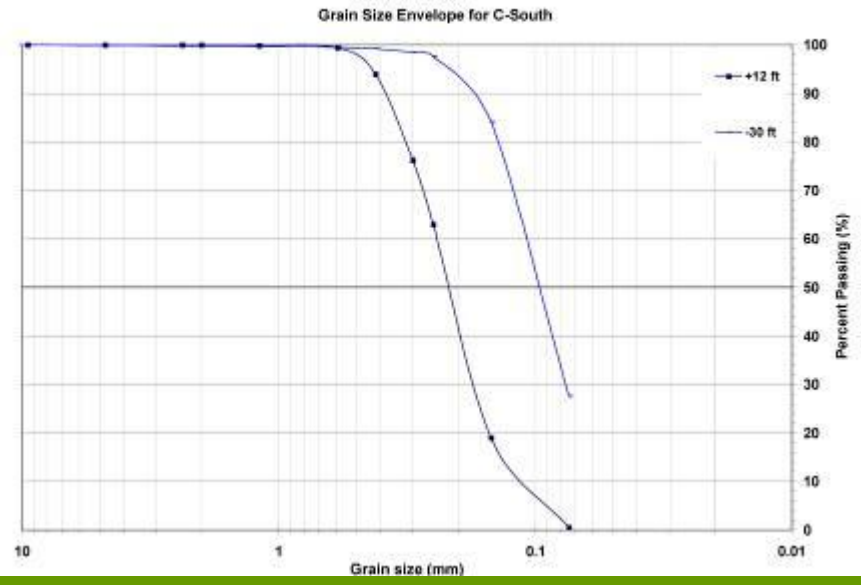
Existing Sand Gradation Curves for Solana Beach



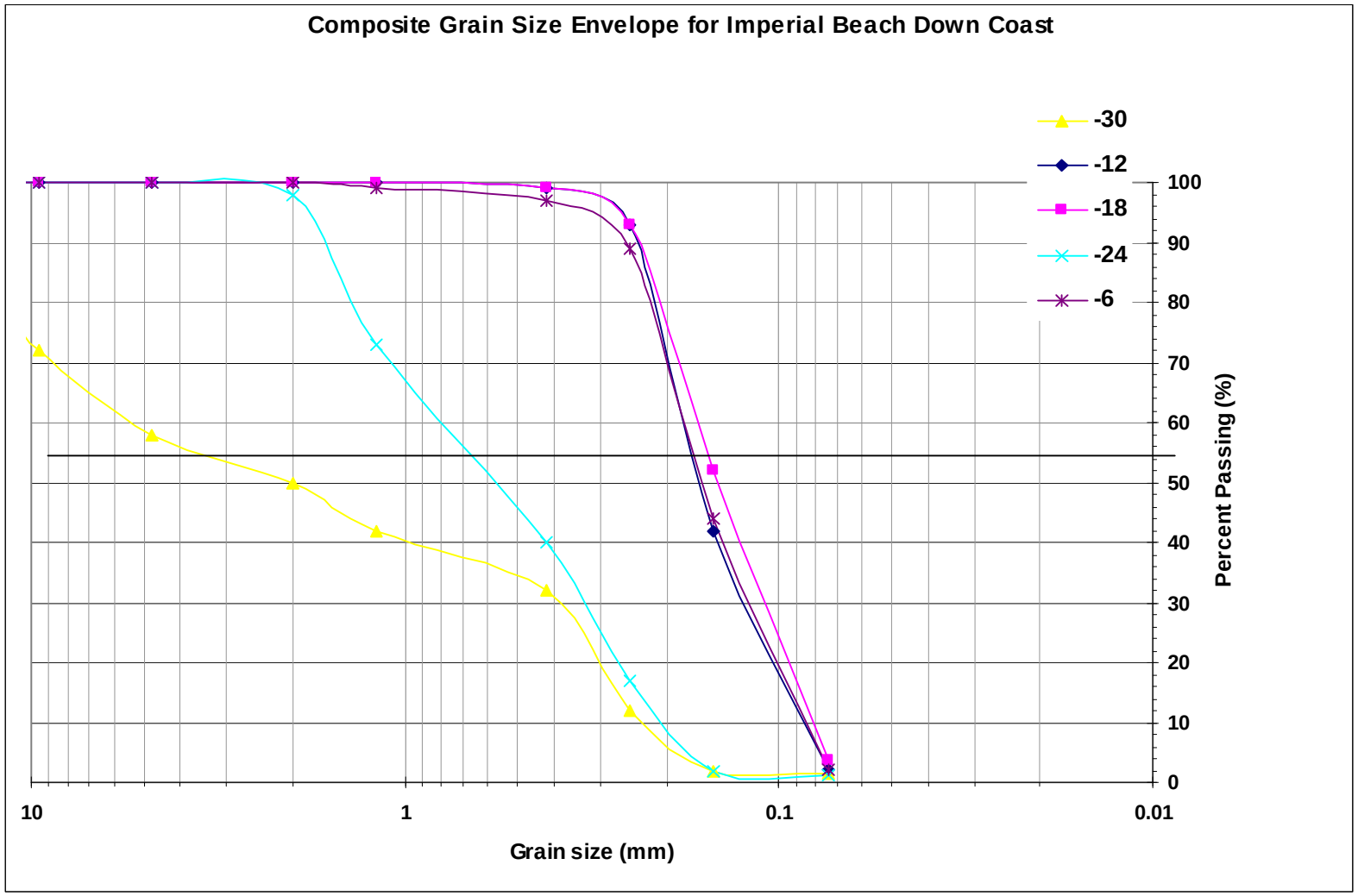


Existing Sand Gradation Curves for Coronado

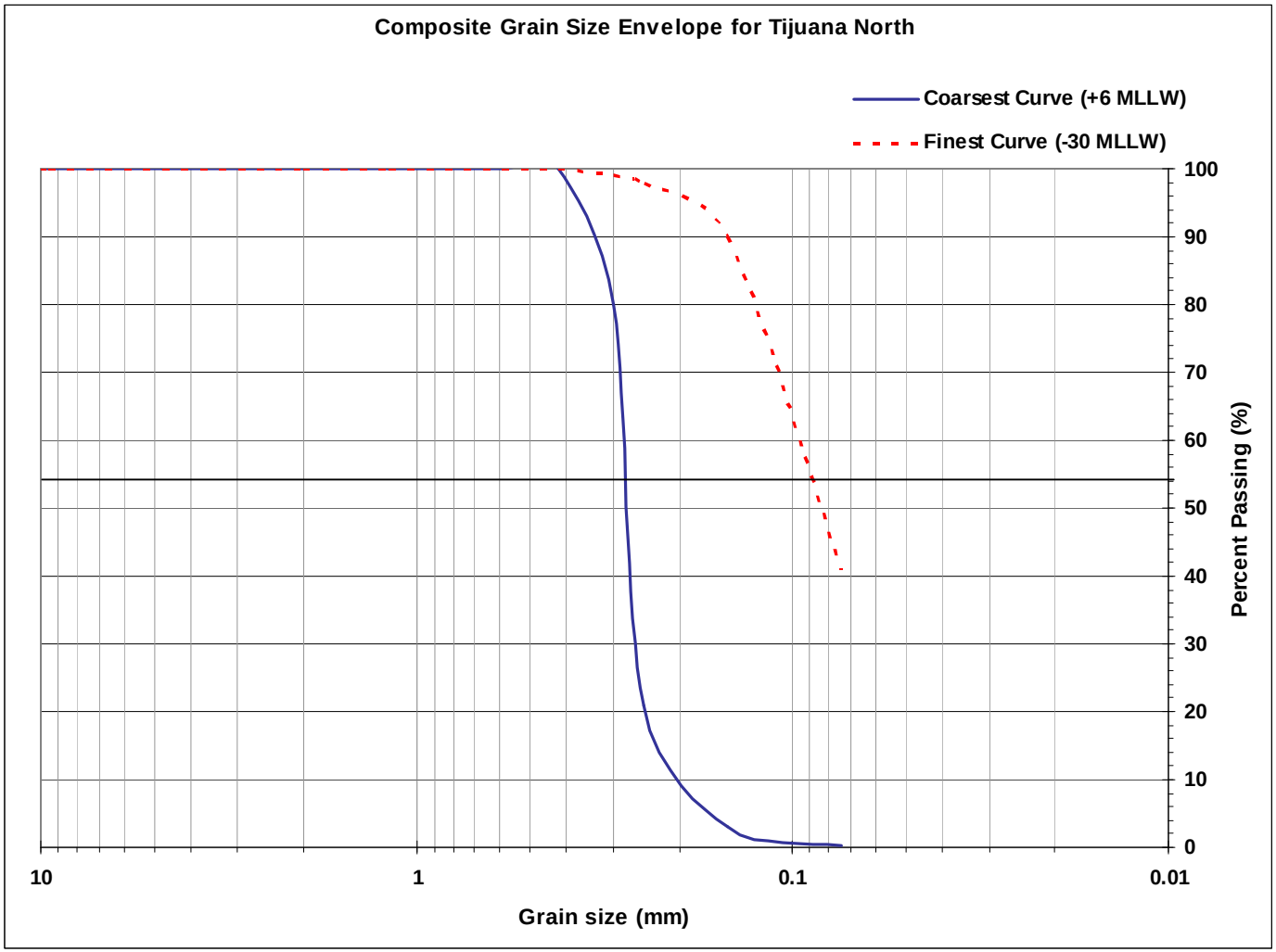




Existing Sand Gradation Curves for Imperial Beach



Existing Sand Gradation Curves for Tijuana Estuary



APPENDIX D

COST ESTIMATES AND BENEFIT/COST MATRICES

SUMMARY OF ENGINEERS COST ESTIMATE AND B/C RATIO

Item Units	Annual Cost $/YR	Avg. Annual Nourishment Volume CY/YR	Benefit $/YR	B/C Ratio
Alternative 1 - No mgmt devices, 1 M CY/YR, upland (0% fines) and offshore sediment	$37,020,026	1,000,000	$18,740,321	0.5
Alternative 1 - No mgmt devices, 1 M CY/YR, upland (25% fines) and offshore sediment	$30,455,257	1,000,000	$18,740,321	0.6
Alternative 2 - No mgmt devices, 1 M CY/YR, offshore sedimemt	$18,211,709	1,000,000	$18,740,321	1.0
Alternative 3 - Management devices, 500 K CY/YR, upland sediment	$25,968,700	500,000	$18,740,321	0.7
Alternative 4 - Management devices, 500 K CY/YR, offshore sediment	$15,707,571	500,000	$18,740,321	1.2

Notes/Assumptions:
Costs in 2009$.
Costs include: construction, construction management, engineering, environmental review, contingency, monitoring, and maintenance.
Interest equals inflation = 5%.
50 year project lifetime.
Sediment management devices are pre-filled and maintained at year 25.
No retention beach benefit/volume ratio ($/CY) is derived from SANDAG and Moffatt & Nichol (2007) and indexed to 2009$. 18.74
Benefit/volume ratio ($/CY) with management devices is twice the no retention value due to an assumed doubling of efficiency. 37.48
Benefits iInclude recreation benefits and protection of public property from storm damage.
K=thousand, CY=cubic yards, YR=year, B/C=benefit to cost ratio.

Reference:
SANDAG and Moffatt & Nichol. 2007. *Feasibility Study, San Diego Regional Beach Sand Replenishment Project, San Diego, California.* Prepared for the California Department of Boating and Waterways. August 2007.

ENGINEERS COST ESTIMATE

ALTERNATIVE 1 - NO MGMT DEVICES, 1 MCY/YR OF A COMBINATION OF UPLAND AND OFFSHORE SAND

0% Fines in Upland

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Average Annual Nourishment	1,000,000			
	Annual Upland Nourishment				
1	Mobilize Demobilize Equipment	20	PROJ	$25,000	$500,000
2	Excavate Haul, Spread	895,000	CY	$25.00	$22,375,000
3	Subtotal				$22,875,000
	Offshore Nourish Every 5 Years				
4	Mob & Demob Dredge, Pipeline & Dozers	1	LS	$2,100,000	$2,100,000
5	Dredge, Hopper, Pipeline, Spread	525,000	CY	$10.00	$5,250,000
6	Subtotal				$7,350,000
7	Annualized Subtotal=Subtotal*i(1+i)^n/((1+i)^n-1)	5	YR		$1,697,665
8	Annual Monitoring	1	LS	$107,352	$107,352
	Subtotal				$24,680,017
	Contingency			25%	$6,170,004
	Permits			5%	$1,234,001
	Environmental Review			5%	$1,234,001
	Final Engineering, Bid Documents, Construction Support			10%	$2,468,002
	Construction Management			5%	$1,234,001
	Grand Total				**$37,020,026**

25% Fines in Upland

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Average Annual Nourishment	1,000,000			
	Annual Upland Nourishment				
1	Mobilize Demobilize Opportunistic Equipment	20	PROJ	$25,000	$500,000
2	Excavate, Haul, Spread	671,250	CY	$25.00	$16,781,250
3	Subtotal				$17,281,250
	Offshore Nourish Every 5 Years				
4	Mob & Demob Dredge, Pipeline & Dozers	1	LS	$2,100,000	$2,100,000
5	Dredge, Hopper, Pipeline, Spread	1,643,750	CY	$6.40	$10,520,000
6	Subtotal				$12,620,000
7	Annualized Subtotal=Subtotal*i(1+i)^n/((1+i)^n-1)	5	YR		$2,914,902
8	Annual Monitoring	1	LS	$107,352	$107,352
	Subtotal				$20,303,504
	Contingency			25%	$5,075,876
	Permits			5%	$1,015,175
	Environmental Review			5%	$1,015,175
	Final Engineering, Bid Documents, Construction Support			10%	$2,030,350
	Construction Management			5%	$1,015,175
	Grand Total				**$30,455,257**

Assumptions

Dredge sand from offshore, hopper transport, to pipeline to beach where dewatered and spread.

Soft costs (contingency, permits, env review, engineering, const mgmt) are an annual value.

Interest rate (i) equals inflation rate (e) over project lifetime = 5%

Dredge unit and mob & demob cost based on 2001 SANDAG RBSP indexed to $2009.

Upland unit costs and Mob & demob cost based on M&N Sta. River to S. Clemente Beach

Monitoring Cost from SANDAG 2008 Annual Retreat, Session F, January 31, 2008, indexed to 2009$.

LS=lump sum, CY=cubic yard, YR=year, PROJ=project

ENGINEERS COST ESTIMATE					
ALTERNATIVE 2 - NO MANAGEMENT DEVICES, 1 MCY/YR OF OFFSHORE SEDIMENT					
ITEM NO.	**ITEM DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT COST**	**SUBTOTAL**
	Offshore Nourish Every 5 Years				
1	Mob & Demob Dredge, Pipeline & Dozers	1	LS	$2,100,000	$2,100,000
2	Dredge, Hopper, Pipeline, Spread	5,000,000	CY	$10.00	$50,000,000
3	Subtotal				$52,100,000
4	Annualized Subtotal=Subtotal*i(1+i)^n/((1+i)^n-1)	5	YR		$12,033,787
5	Annual Monitoring	1	LS	$107,352	$107,352
	Subtotal				$12,141,139
	Contingency			25%	$3,035,285
	Permits			5%	$607,057
	Environmental Review			5%	$607,057
	Final Engineering, Bid Documents, Construction Support			10%	$1,214,114
	Construction Management			5%	$607,057
	Grand Total				**$18,211,709**
	Assumptions				
	Dredge sand from offshore, hopper transport, to pipeline to beach where dewatered and spread.				
	Soft costs (contingency, permits, env review, engineering, const mgmt) are an annual value.				
	Interest rate (i) equals inflation rate (e) over project lifetime =				5%
	Dredge unit and mob & demob cost based on 2001 SANDAG RBSP indexed to $2009.				
	Monitoring Cost from SANDAG 2008 Annual Retreat, Session F, January 31, 2008, indexed to 2009$.				
	LS=lump sum, CY=cubic yard, YR=year				

ENGINEERS COST ESTIMATE

ALTERNATIVE 3 - MANAGEMENT DEVICES, 500 KCY/YR OF ALL UPLAND SEDIMENT

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Sediment Management Devices				
1	Groin Fields	2	EA	$8,938,555	$17,877,110
2	Reefs	4	EA	$9,055,131	$36,220,522
3	Breakwaters	1	EA	$22,670,621	$22,670,621
4	Subtotal				$76,768,253
5	Annualized Subtotal=Subtotal*i(1+i)^n/((1+i)^n-1)	50	YR		$4,205,114
	Annual Upland Nourishment				
6	Mob & Demob	20	PROJ	$25,000	$500,000
7	Excavate, Haul, Spread	500,000	CY	$25.00	$12,500,000
8	Subtotal				$13,000,000
9	Annual Monitoring	1	LS	$107,352	$107,352
	Subtotal				$17,312,467
	Contingency			25%	$4,328,117
	Permits			5%	$865,623
	Environmental Review			5%	$865,623
	Final Engineering, Bid Documents, Construction Support			10%	$1,731,247
	Construction Management			5%	$865,623
	Grand Total				**$25,968,700**

Assumptions

Dredge sand from offshore, hopper transport, to pipeline to beach where dewatered and spread.

Soft costs (contingency, permits, env review, engineering, const mgmt) are an annual value.

Interest rate (i) equals inflation rate (e) over project lifetime = 5%

Upland unit costs and Mob & demob cost based on M&N Sta. River to S. Clemente Beach

Management devices are pre-filled. Costs from Moffatt & Nichol (2001). indexed to $2009.

Management devices maintenance @ year 25 included.

Monitoring Cost from SANDAG 2008 Annual Retreat, Session F, January 31, 2008, indexed to 2009$.

LS=lump sum, CY=cubic yard, YR=year

ENGINEERS COST ESTIMATE

ALTERNATIVE 4 - MANAGEMENT DEVICES, 500 KCY/YR OF ALL OFFSHORE SEDIMENT

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Sediment Management Devices				
1	Groin Fields	2	EA	$8,873,695	$17,747,391
2	Reefs	4	EA	$8,990,271	$35,961,084
3	Breakwaters	1	EA	$21,231,082	$21,231,082
4	Subtotal				$74,939,557
5	Annualized Subtotal=Subtotal*i(1+i)^n/((1+i)^n-1)	50	YR		$4,104,944
	Offshore Nourish Every 5 Years				
6	Mob & Demob Dredge, Pipeline & Dozers	1	LS	$2,100,000	$2,100,000
7	Dredge, Hopper, Pipeline, Spread	2,500,000	CY	$10.00	$25,000,000
8	Subtotal				$27,100,000
9	Annualized Subtotal=Subtotal*i(1+i)^n/((1+i)^n-1)	5	YR		$6,259,417
10	Annual Monitoring	1	LS	$107,352	$107,352
	Subtotal				$10,471,714
	Contingency			25%	$2,617,928
	Permits			5%	$523,586
	Environmental Review			5%	$523,586
	Final Engineering, Bid Documents, Construction Support			10%	$1,047,171
	Construction Management			5%	$523,586
	Grand Total				**$15,707,571**

Assumptions

Dredge sand from offshore, hopper transport, to pipeline to beach where dewatered and spread.

Costs includes project monitoring and structure maintenance.

Soft costs (contingency, permits, env review, engineering, const mgmt) are an annual value.

Interest rate (i) equals inflation rate (e) over project lifetime = 5%

Dredge unit and mob & demob cost based on 2001 SANDAG RBSP indexed to 2009$.

Management Devices are pre-filled. Costs from Moffatt & Nichol (2001). indexed to 2009$.

Management devices maintenance @ year 25 included.

Monitoring Cost from SANDAG 2008 Annual Retreat, Session F, January 31, 2008, indexed to 2009$.

LS=lump sum, CY=cubic yard, YR=year

APPENDIX E

COASTAL MARINE HABITAT DATA

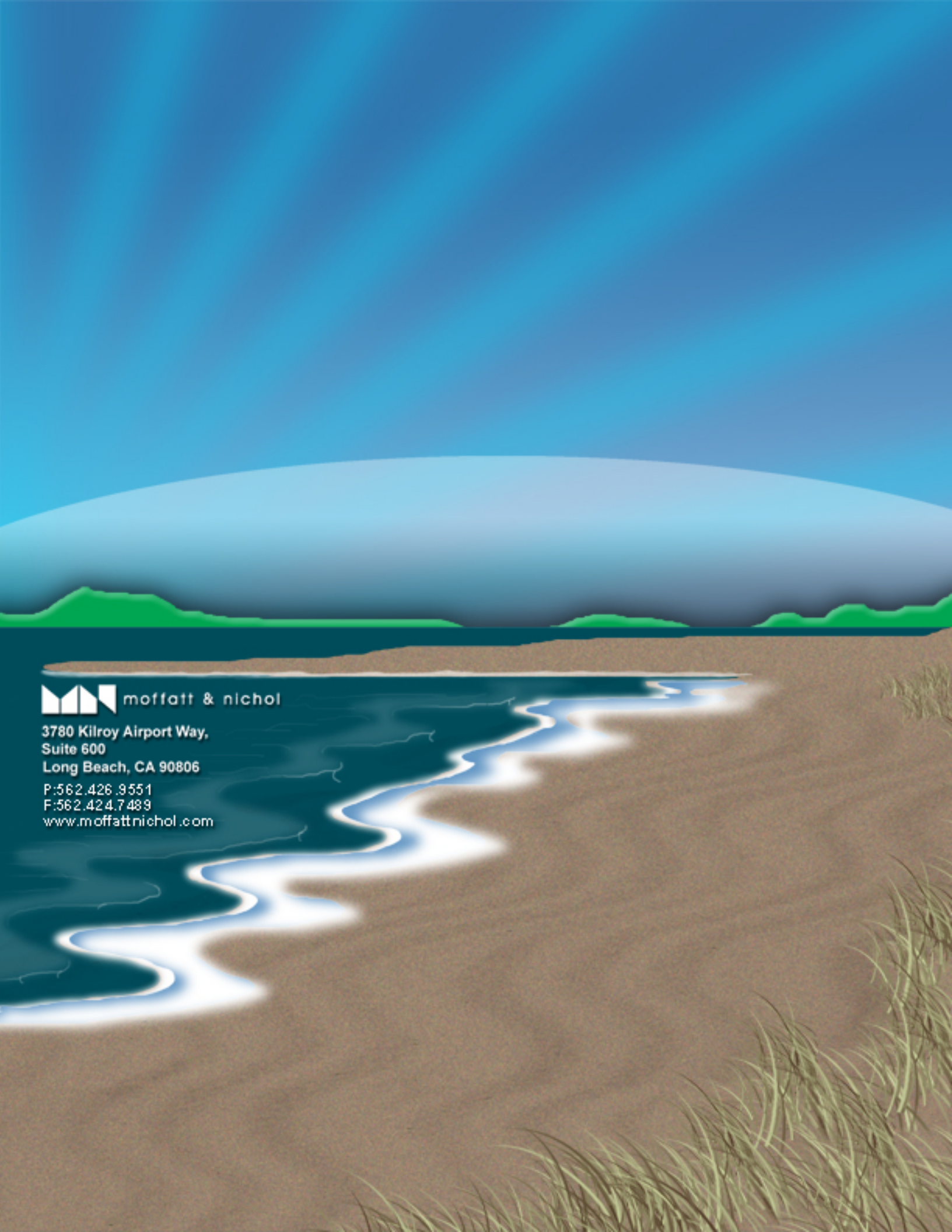
Table E-1. Sensitive Biota in the Vicinity of Sediment Management Areas.

Site	Surfgrass	Nearshore Reefs	Kelp Beds	Other Rocks/Pier	Bay/ Lagoon Inlet	Least Tern Nesting	Snowy Plover		
							Critical Habitat	Nesting Area	Wintering
South Oceanside onshore	> 1 mile	> 4,300 ft	> 2,500 ft	Rocks offshore	> 3,900 ft	> 2 miles	> 1 mile	> 2 miles	>3,900 ft
South Oceanside Nearshore	> 1 mile	> 4,300 ft	> 2,500 ft	Rocks within site	> 2,600 ft	> 2 miles	> 1 mile	> 2 miles	>3,900 ft
North Carlsbad onshore	Offshore	Offshore	Offshore	NA	> 1,000 ft	> 2 miles	> 2 miles	> 2 miles	Within
Aqua Hedionda onshore	660 ft upcoast	North & South ends	North & South ends	Rocks offshore	<200 ft	> 2 miles	> 2 miles	> 2 miles	Within
South Carlsbad onshore	Offshore	Localized	Localized	Rocks offshore	> 1 mile	> 2 miles	> 2 miles	> 2 miles	Within
Batiquitos Beach onshore	Offshore	Offshore	Offshore	NA	>1,500 ft	>800 ft	Adjacent	>800 ft	Partially Within
Batiquitos Nearshore	> 1,000 ft	> 1,000 ft	> 500 ft	NA	> 700 ft	> 1,000	> 600 ft	> 1,000	> 500 ft
Moonlight Beach onshore	> 700 ft	>700 ft	> 900 ft	Rocks Offshore	> 2 miles	> 2 miles	> 2 miles	> 2 miles	> 2 miles
Cardiff onshore	> 1,000 ft	> 600 ft	> 1,000 ft	NA	>1,100 ft	> 1 mile	> 2 miles	> 1 mile	Within
Cardiff nearshore	> 1,300 ft	> 600 ft	> 400 ft	Pipeline Ballast	> 1,500 ft	> 1 mile	> 2 miles	> 1 mile	> 400 ft
Solana Beach (Fletcher Cove) onshore	> 300 ft	> 300 ft	> 800 ft	Rocks offshore	> 1 mile	> 1 mile	> 2 miles	> 1 mile	> 1,300 ft
San Dieguito Lagoon onshore	Offshore north site	> 300 ft	> 1,300 ft	NA	> 300 ft	> 2 miles	> 2 miles	> 2 miles	Within
San Dieguito Nearshore	> 1,900 ft	> 1,500 ft	> 1,500 ft	NA	> 1,000 ft	> 2 miles	> 2 miles	> 2 miles	> 300 ft
Torrey Pines onshore	Offshore	> 800 ft	> 1,900 ft	Cobble offshore	> 800 ft	> 2 miles	> 400 ft	> 2 miles	Within
Torrey Pines Nearshore	> 150 ft	> 1,500 ft	> 1,300 ft	Cobble nearby	> 1,300 ft	> 2 miles	> 900 ft	> 2 miles	> 300 ft

Table E-1. (Continued)

Site	Surfgrass	Nearshore Reefs	Kelp Beds	Other Rocks/ Pier	Bay/ Lagoon Inlet	Least Tern Nesting	Snowy Plover		
							Critical Habitat	Nesting Area	Wintering
Mission Beach onshore	> 1 mile	> 3,500 ft	> 1 mile	NA	> 1 mile	> 3,500	> 2 miles	> 3,500	Within
Mission Beach Nearshore	> 4,000 ft	> 400 ft	> 2,500 ft	Small patch within site	> 1 mile	> 4,000	> 2 miles	>4,000	> 300 ft
Ocean Beach onshore	> 1 mile	> 300 ft	> 2,600 ft	Rocks Offshore, > 1,300 ft from pier	> 1,500 ft	> 1,300 ft	> 2 miles	> 3,500	Within
Coronado Beach onshore	> 1 mile	> 1 mile	> 2 miles	> 2,600 ft	> 1 mile	> 1 mile	Adjacent	> 1,300 ft	Within
Coronado Beach Nearshore	> 1 mile	> 1 mile	> 2 miles	> 2,600 ft	> 1 mile	> 1 mile	> 600 ft	> 1,400 ft	> 300 ft
Imperial Beach onshore	> 2 miles	> 1,000 ft	> 2,300 ft	> 800 ft from pier	> 3,000 ft	> 2,300 ft	Adjacent	> 2,300 ft	Adjacent
Imperial Beach Nearshore (North)	> 2 miles	> 500 ft	> 500 ft	> 900 ft from pier	> 2 miles	> 1 mile	> 1 mile	> 600 ft	> 600 ft
Imperial Beach Nearshore (South)	> 2 miles	Adjacent	> 850 ft	Rocks within site; > 800 ft from pier	> 3,500 ft	> 2,600 ft	>400 ft	> 2,600 ft	> 400 ft
Tijuana Estuary onshore	> 2 miles	> 3,500 ft	> 3,500 ft	> 3,500 ft	> 800 ft	Adjacent	Within	Adjacent	Within

Note: Maximum distances were reported as > 2 miles
* = New site



moffatt & nichol

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

P:562.426.9551
F:562.424.7489
www.moffattnichol.com