DRAFT

COASTAL REGIONAL SEDIMENT MANAGEMENT PLAN

FOR THE SAN DIEGO REGION

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December 2008

EXECUTIVE SUMMARY

This San Diego Coastal Regional Sediment Management Plan (Coastal RSM Plan) has been developed by the San Diego Association of Governments (SANDAG) and the California Sediment Management Workgroup (CSMW). This Coastal RSM Plan is presented to the public and decision-makers to inform the region of solutions proposed for existing sediment management problems along the coast. Insufficient coastal sediment (sand) volumes exist along the San Diego County shoreline, leading to erosion, narrowing of beaches, damage to infrastructure, habitat impacts, and reduced recreational and economic benefits. Historical records indicate that as the region has developed, flood control works, harbors, and urbanization have resulted in a reduction in the supply of sediment to the shore by approximately 400,000 cubic yards of sand per year. SANDAG prepared the Shoreline Preservation Strategy (SPS) in 1993 concluding that the region needed approximately 30 million cubic yards of sand for initial restoration, and nearly 400,000 cubic yards per year thereafter for maintenance. This information is used as a guideline for comprehensive nourishment needed for the San Diego region in this Coastal RSM Plan. Conclusions presented in this Plan are summarized below.

Coastal Processes

This region's coast is separated into three littoral cells. The Oceanside Littoral Cell is located from Oceanside Harbor to Point La Jolla. The Mission Bay Cell is located from Point La Jolla to San Diego Bay, and the Silver Strand Cell is from San Diego Bay into Mexico. Coastal processes in this region are affected by waves driving longshore currents and sediment transport. This coast is exposed to waves from both the northern and southern hemispheres through a very broad window. Wave approach directions extend from the northwest, through all western windows, to nearly due south. Longshore currents and sediment transport is consequently variable, depending on season and climatic cycle. Higher energy waves from the Pacific Northwest are the most influential wave conditions and drive net longshore transport to the south in the Oceanside and Mission Bay Littoral Cells. 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. However, the net longshore transport rate is relatively small in all cells indicating significant bi-directional transport in the region. All cells experience sediment deficits in their sediment budgets indicating ongoing sand loss.

Habitat Constraints

Significant environmental constraints exist within this region in the form of sensitive marine habitat. Existing habitat includes nearshore reefs, surf grass beds, kelp forests, eelgrass meadows, offshore cobbles and rocks, sandy beach, sandy intertidal, lagoons, rivers, bays/harbors, and coastal dune and strand. Most sensitivity exists at vegetated areas on hard bottom such as surf grass, kelp, and eelgrass, while other areas such as lagoons and certain sandy areas are also sensitive due to their inhabitants and site use.

Sand Sources

Potential sources of sediment for beaches in the region include nearly 60 presently-known sites ranging from upland, to coastal wetlands and harbors, to offshore. Offshore sources are actively being investigated by SANDAG, Scripps Institute of Oceanography (SIO), and others. Most sources exist within the coastal zone, with fewer upland sources located away from the coast. Stockpiling of sediment will likely be necessary to facilitate truck delivery from upland sources to the coast. Constraints to delivering sediment include prohibitive costs to deliver sand from some upland development projects, and environmental windows at the beach.

Sand Receiver Sites

Receiver sites deemed suitable for the Coastal RSM Plan include 26 sites along the coast from Oceanside to Imperial Beach that are documented to be eroding or in a deficit of sediment. Sites identified as suitable include:

- On-shore sites presently being permitted (or already permitted) for opportunistic beach fill programs (surplus sand from development projects that may be inexpensive or potentially free), with sites added that are most readily accessible from major highways at areas of need

- On-shore sites used by SANDAG in 2001 for regional nourishment;

- On-shore and nearshore sites used previously by the U.S. Army Corps of Engineers (USACE) and U.S. Navy for discharge of maintenance-dredged materials from various sources; and

- On-shore sites presently used for lagoon and harbor maintenance dredging, and both on-shore and nearshore sites anticipated to be useful for future lagoon restoration and maintenance.

SIO is studying the phenomena of lagoon mini-cells of sediment transport that may guide or dictate the most appropriate sand receiver sites. Near lagoons, longshore sediment transport tends to convert to offshore sediment transport resulting in sand lost from the beach. This hypothesis is being formalized and will be incorporated into this document as soon as it is published and more definitive.

Solutions

Restoration of the region's beaches would require a long-term sustained effort. Two approaches are presented for consideration. Both alternatives assume sand sources will consist of opportunistic programs and/or from offshore sand dredging. One alternative considers nourishment only, while the other alternative considers nourishment and sediment management devices with the goal of retaining more sand over time.

Alternative One

Management Alternative One envisions placement of approximately 1,000,000 cubic yards of sand per year on the region's beaches to counteract effects of reduced natural sand supplies (400,000 cubic yards per year), and to achieve the 30 million cubic yard goal in 50 years (600,000 cubic yards per year).

Scenario One for this alternative assumes that all opportunistic beach fill programs are active to the maximum extent each year and contribute approximately 800,000 cubic yards of sand to the region. The balance of 200,000 cubic yards of sand 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 consist of between 1,000,000 and 2,000,000 cubic yards of sand, respectively.

Scenario Two for this alternative assumes that opportunistic beach fill programs are not active and contribute very little to no sand to the region. The entire quantity of 1,000,000 cubic yards of sand per year would be provided by larger-scale nourishment programs of SANDAG, the USACE, or both. These larger-scale projects would occur on frequency of every 5 to 10 years and consist of between 5,000,000 and 10,000,000 cubic yards of sand, respectively.

Alternative Two

Management Alternative Two envisions placement of sediment management devices at appropriate locations throughout the San Diego region, pre-filling with an appropriate quantity of sand (to be determined), and nourishment with approximately 500,000 cubic yards of sand per year. This approach would likely lead to reduced costs over time and potentially accomplish the 30 million cubic yard goal quicker than management Alternative One. Sediment management devices are assumed to reduce the need for nourishment by 50 percent, and this assumption requires verification in a future study. Alternative Two assumes that sand losses are significantly reduced or eliminated, and nearly the entire annual nourishment volume of 500,000 cubic yards per year goes toward meeting the 30 million cubic yard regional target. Together with the sand volume placed as pre-fill and the positive effects of retention, this annual nourishment rate should also result in 30 million cubic yards of sand placed over 50 years or less. This rate of sand accumulation throughout the region with sediment management devices in place also requires verification in a future study.

Scenario One of Alternative Two also assumes that all opportunistic beach fill programs are active to the maximum extent each year and can contribute approximately 800,000 cubic yards of sand per year (or all of the quantity needed).

Alternatively, Scenario Two of Alternative Two assumes only offshore sand would be provided for nourishment by SANDAG and/or the USACE every 5 to 10 years consisting of between 2,500,000 and 5,000,000 cubic yards of sand per project.

The recommended Coastal RSM Plan for the San Diego Region consists of installing sediment management devices and using primarily offshore sand as nourishment at a rate of 500,000 cubic yards per year. Proportional placement of materials dredged from lagoons and harbors is also recommended, and is addressed below.

Proportional Placement of Maintenance-Dredged Materials

Another component of the plan is referred to as proportional placement of existing maintenance dredging materials from lagoons and harbors. Existing practices call for placement of certain sand proportions from lagoons and harbors upcoast rather than downcoast. Proportional placement recommends that the sand be placed primarily downcoast to reduce return shoaling in the source lagoon/harbor, if other conditions do not exist that require its placement at an upcoast site.

Other elements of the Coastal RSM Plan include project economics, funding, permitting, governance, impediments, monitoring, filling of data gaps, and next steps. Each Plan element is summarized below.

Economic Feasibility

Project economics are favorable for either Alternative with a benefit-to-cost ratio higher than 1.0 for use of offshore sand. The benefit-to-cost ratio is less than 1.0 for using opportunistic sand due to high incremental costs of delivery. Projects should focus on using offshore sand until a cost reduction for use of upland sand or additional funding source can be realized. Sand management devices reduce long-term costs compared to not using management devices by approximately 25 percent, as recently estimated by SANDAG for future budgeting.

Funding Sources

Funding sources include various means to generate revenue such as:

- Regional sales taxes;
- Car rental fees;
- Transient occupancy taxes;
- Property tax assessments;
- Parking fees;

- Development impact fees; and
- A new concept referred to as the inland sand transport offset fund.

Each of these mechanisms can generate additional revenue for implementing the plan and more than one source may be needed at any one time to render the proposed actions viable.

Permitting Requirements

Streamlined regulatory compliance should be considered that consists of securing regional permits from jurisdictional agencies. Similar to opportunistic beach fill programs, regional general permits (or RGPs, such as existing RGP 67 of the USACE, Los Angeles District) should 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.

An on-going process of the Marine Life Protection Act (MLPA) initiative is determining the sensitivity of offshore areas throughout this region. The Coastal RSM Plan and MLPA need to integrate to meet the needs of both programs. Meeting the mutual needs could be accomplished through coordination and information sharing between the groups leading these efforts, and developing respective plans consistent with constraints of the other program. SANDAG is communicating with the MLPA leaders and is participating in their process to maximize coordination. Regional stakeholders need to actively participate in the MLPA process to inform the State of multiple benefits of nourishment as documented by SANDAG from their first Regional Beach Sand Project (RBSP I).

Governance Structure and Implementation

Governance measures available to implement the Coastal RSM Plan include:

- Integrating the plan into CEQA, the California Coastal Act, Local Coastal Programs, Local Zoning Ordinances, General Plans, and local permit processing – These efforts would be focused on requiring developers to address consistency with the Plan for their projects, or present evidence justifying non-compliance with the Plan;
- Reducing developer fees with compliance – Creating economic incentives for developers to comply with the Plan by providing reduced fees commensurate with nourishment contributions;
- Setting up "Sediment Sheds/Littoral Cell" Planning entity to coordinate activities with watershed and other groups – Create one group to proactively research and identify sediment that should be contributed to the coast and to coordinate re-use of sediment to maximize compliance with the Plan; and

- Establishing regional general permits – Perform environmental review and establish a general permit program for approval by all agencies to implement the Coastal RSM Plan.

Impedances

Impedances to the Plan include certain existing or future legislation, 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 of paramount importance to beach nourishment as regional sediment management. One process, the Marine Life Protection Act, can sufficiently restrict nourishment and offshore dredging as to render management ineffective. SANDAG, stakeholders, and the CSMW must actively participate in the MLPA process if regional sediment management is to successfully occur. The other process is development of Total Maximum Daily Loads (TMDLs) for sediment in the San Diego Region by the Regional Water Quality Control Board. This process can significantly restrict sediment delivery to the coast, and SANDAG and stakeholders need to also intercede, coordinate, and inform the TMDL process of benefits of regional sediment management.

Monitoring

Regional monitoring will be required for permits. Existing monitoring being performed by SANDAG is a basis for devising a monitoring plan that is most efficient and cost-effective for this regional program. Monitoring and reporting extending from present SANDAG efforts will be required for biology, beach profiles, and lagoon shoaling to verify effects and potential impacts to refine the Coastal RSM Plan. Results will be incorporated into the Plan to optimize it and improve its effectiveness.

Data Gaps and Recommended Next Steps

Data gaps exist that need to be filled include:

- Sediment gradation data for all Coastal RSM Plan beaches (except those already characterized at South Oceanside, Batiquitos Beach, Moonlight Beach, Fletcher Cove, Coronado Beach, Imperial Beach, and Border Field State Park) to establish the grain size envelope for receiver beaches for permits; and
- More complete and updated sediment source information throughout the region to prepare a standardized inventory/repository of data for targeting promising opportunities.

Additional analyses are also needed and include:

- On-going evaluation of the most recent longshore sediment transport data from the SIO California Data Information Program (CDIP) program to determine appropriate proportional placement scenarios for lagoon and harbor maintenance;

- Integration of the mini sub-cell analysis being studied by SIO into this Coastal RSM Plan;
- Estimation of environmental habitat benefits expressed as dollars for future benefit/cost analyses required for state grant funding;
- Evaluation of actual project performance as compared to model predictions to improve the models for future use;
- Quantification of the risk to sensitive reef areas from sedimentation, relative to sand placement volume and/or frequency;
- Effect of sand retention measures on reducing future nourishment quantities and shortening the time-frame to nourish the region with 30 million cubic yards;
- Continued evaluation of potential offshore sources of sediment through multi-beam bathymetry (backscatter) and seismic reflection/refraction profiling such as that being pursued in the are by USGS and SIO researchers (as performed by SANDAG for RBSPs I and the future RBSP II in 2011 or 2012).

Next steps include short- and long-term actions to initiate plan recommendations listed below

Short-Term Next Steps

1. Continue education of the public on the need for regional sediment management.
2. Work with local agency staff to understand the need for the Coastal RSM Plan and develop strategies for them to integrate it within their jurisdictional authorities.
3. Prepare a programmatic CEQA/NEPA document for implementation.
4. Implement short-term Coastal RSM Plan measures at Cities such as:
    a. Indicate whether RSM receiver sites are acceptable, and/or revise previous SANDAG RBSP sites;
    b. Indicate any interest in sand management devices;
    c. Acquire sediment gradation data for receiver sites not sampled since 2005;
    d. Update list of possible sediment sources including location, quantity, and frequency of availability; and
    e. Update possible stockpile locations.
5. Update the Shoreline Preservation Strategy to include new information from the RBSPs and advances in science and technology since its adoption.
6. Conduct a feasibility study of installing off-loading sites where appropriate as part of any railroad double-tracking project to facilitate transport by rail.

7. Develop a first-order (shallow-level) regional sediment monitoring program to monitor all elements of the Coastal RSM Plan to provide updates. This program should be supplemented by more detailed project-specific monitoring of the following to achieve more comprehensive and efficient monitoring to better implement projects:
    a. Lagoon sedimentation for maintenance dredging;
    b. Waves and longshore sediment transport;
    c. River discharge;
    d. Sedimentation/erosion along the coast from beach profiles;
    e. Nearshore reef conditions of sedimentation; and
    f. Effects on surfing.
8. Work with the San Diego RWQCB to promote transport of sediment to the coast when considering TMDLs and sediment detention basins.
9. Work within the MLPA initiative process to inform policy and decision-makers of the multiple benefits of nourishment documented by RSBP I.
10. Coordinate with each watershed manager to facilitate continued coastal sediment yield.

Long-Term Next Steps

1. Establish at least an appropriate "sediment shed" authority to coordinate sediment availability and include their participation on the Shoreline Preservation Working Group (SPWG).
2. Integrate longshore sediment transport estimates from the SIO CDIP program into the living document data base, considering lagoon-subcells.
3. Take a systematic approach to local agency implementation when projects are applied for, with City staff or the sediment shed authority performing the initial evaluation for candidacy.
4. Establish one or several Regional 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.
5. 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).
6. Implement action steps by SANDAG such as:
    a. Install sand 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 sand for Fletcher Cove) after monitoring results are assessed.

7. Link watershed and sediment management planning in order to:

   a. Leverage federal and state funding; and
   b. Provide incentives to the private sector through reduced fees.

8. Create a secure funding stream by establishing a funding strategy.

9. Impose fees on dam owners that impound sediment for infrastructure maintenance and document local efforts as matches.

10. Utilize data from the pilot projects to update the Coastal RSM Plan such as the Tijuana Estuary Fate and Transport Study.

11. Establish uniform monitoring procedures and implement strategic monitoring to support decision-making relative to adaptive management (e.g., optimizing sand placement volumes and/or frequency in areas with sensitive resources) on a regional level.

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 it. SANDAG may need to reconsider the Plan elements on a ten-year basis to keep the plan current and to coordinate information presented in this Plan and the Shoreline Preservation Strategy.

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1.0

INTRODUCTION

The San Diego region 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, and habitat;
- Fulfill the statewide sediment management strategy of the California Coastal Sediment Management Workgroup within the southern reach; and
- Enable SANDAG to establish a vision and procedure to counter beach erosion utilizing State funding.

The location of the San Diego region and its representative shoreline area are shown in **Figure 1**. The San Diego region is committed to preserving beaches for habitat, recreation, economic, and shore and property (infrastructure) protection benefits. The regional governmental entity, the San Diego Association of Governments (SANDAG), has worked with the State of California, the California Coastal Sediment Management Workgroup (CSMW), and local agencies to prepare and adopt ongoing beach preservation strategies. These beach preservation strategies include the:

- Formation and function of the regional Shoreline Preservation Working Group (local political leaders, stakeholders, and interested citizens meeting bi-monthly);
- Shoreline Preservation Strategy (SPS) from 1993 recommending 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 implementing the Sand Compatibility and Opportunistic Use Program (SCOUP) versions I (at Oceanside) and II (at Encinitas, Solana Beach, Coronado, and Imperial Beach);
- Participation in three federal shore protection projects within the region partnering with the U.S. Army Corps of Engineers (USACE);
- Local citizen committees concerned about the beaches at the Cities of Oceanside, Carlsbad, Encinitas, and Imperial Beach; and
- Implementation of individual sand projects to address beach preservation within certain Cities.

Beach preservation is needed 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 significantly interrupted sand delivery from upcoast);
- Natural change to a more energetic wave climate since 1978;
- Reduced rates of sand 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; Patsch and Griggs 2006). As such, the volume of sand in the coastal zone is significantly depleted.

A coastal sediment management budget is a concept showing how the path of sand to, and along the coast is affected by human actions (Inman and Frautschy 1966). It reveals mismanagement, and can serve as a tool to enable improved and effective management. Under recent historic and existing conditions, sediment management in the San Diego region has not been intentionally performed to maintain sand delivery to and along the coast. As such, sand volumes in the local area 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 in existing practices. **Figure 3** shows a conceptual example of effective coastal regional sediment management in a region. The major differences between the two types of sediment management shown in the two figures are 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 of the San Diego region that could be used to offset coastal erosion. The Coastal RSM Plan is a comprehensive guidance and policy document presenting regional sediment management in an expeditious, cost-effective, and resource-protective manner in the San Diego region.

1.1 Background

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

1.1.1 Coastal Processes Summary

Coastal processes control the movement of sediment once it reaches the shore and lead to beach erosion, stability, and/or 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 is separated into distinct geographic areas called littoral cells. Littoral cells are the areas within which sediment moves along the coast, and they are bordered by physical boundaries (e.g., submarine canyons, headlands, harbors) on their up- and downcoast ends. The littoral cells within San Diego County are shown in **Figure 4**. Littoral cells included in this regional plan are the Oceanside Littoral Cell (the southern subcell is south of Oceanside Harbor) to the north, the Mission Bay Cell in the center, and the Silver Strand Cell to the south. Littoral cells were first defined by Inman and Frautschy (1966) and Habel & Armstrong (1978).

Sediment transport within the littoral cells is driven by wave-driven currents. Generally, net sediment moves along the shore from north to south in the North and Central County portions of this region, with transport northward in the South County area. This coast is exposed to waves from all angles of approach ranging from the northwest through the south. The highest waves come from the west/northwest, thereby causing longshore currents to run toward the south the majority of the time. The major exception is at South County where approaching wave crests refract (bend) around the large bathymetric irregularities of Point Loma and the Tijuana River delta, and approach the South County shore at an angle more from the southwest than west/northwest thereby driving currents in a net direction northward. A smaller-scale exception occurs just south of Oceanside harbor where waves refract around a shoal off the harbor entrance and cause a northward current north of the South Jetty.

The sediment budget is a concept by Inman and Frautschy (1966) that allows 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, gaining sand, or is in equilibrium. A negative balance in a cell indicates it is losing sand and the beaches are likely narrowing as a general trend while a positive balance indicates beaches are gaining sand and generally widening. The following sediment budget conditions have been documented within the San Diego Region:

- The southern Oceanside Littoral Cell is characterized by a deficit of nearly 60,000 cubic yards of sand per year (Patsch and Griggs 2006);
- The Mission Bay Littoral Cell is in a deficit of 10,000 cubic yards per year along Mission Beach and a deficit of 7,000 cubic yards per year along Ocean Beach according to the USACE (1990 and 1991), and nearly 40,000 cubic yards per year per Patsch and Griggs (2006); and
- At South County, the deficits in the Silver Strand Littoral Cell range from 65,000 cubic yards per year near the Tijuana River Delta in the south to 40,000 cubic yards per year along the Silver Strand in the north (USACE 1990 and1991).

As a result of extensive study of the San Diego Region by the U.S. Army Corps of Engineers (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 per year annually. Placement of up to 30 million cubic yards of sand on the beach is likely to be infeasible from an environmental standpoint due to potential impacts to sensitive biological habitat. Therefore placement of the sand quantity recommended by the SPS would have to occur in multiple placement projects. The pilot RBSP I project in 2001 confirmed that up to 2.1 million cubic yards of sand can be placed at various sites without causing an adverse environmental impact. Subsequent RBSPs may consider placement of larger sand quantities and revisions to placement areas to determine the maximum sand placement quantity for a project while preventing habitat impacts.

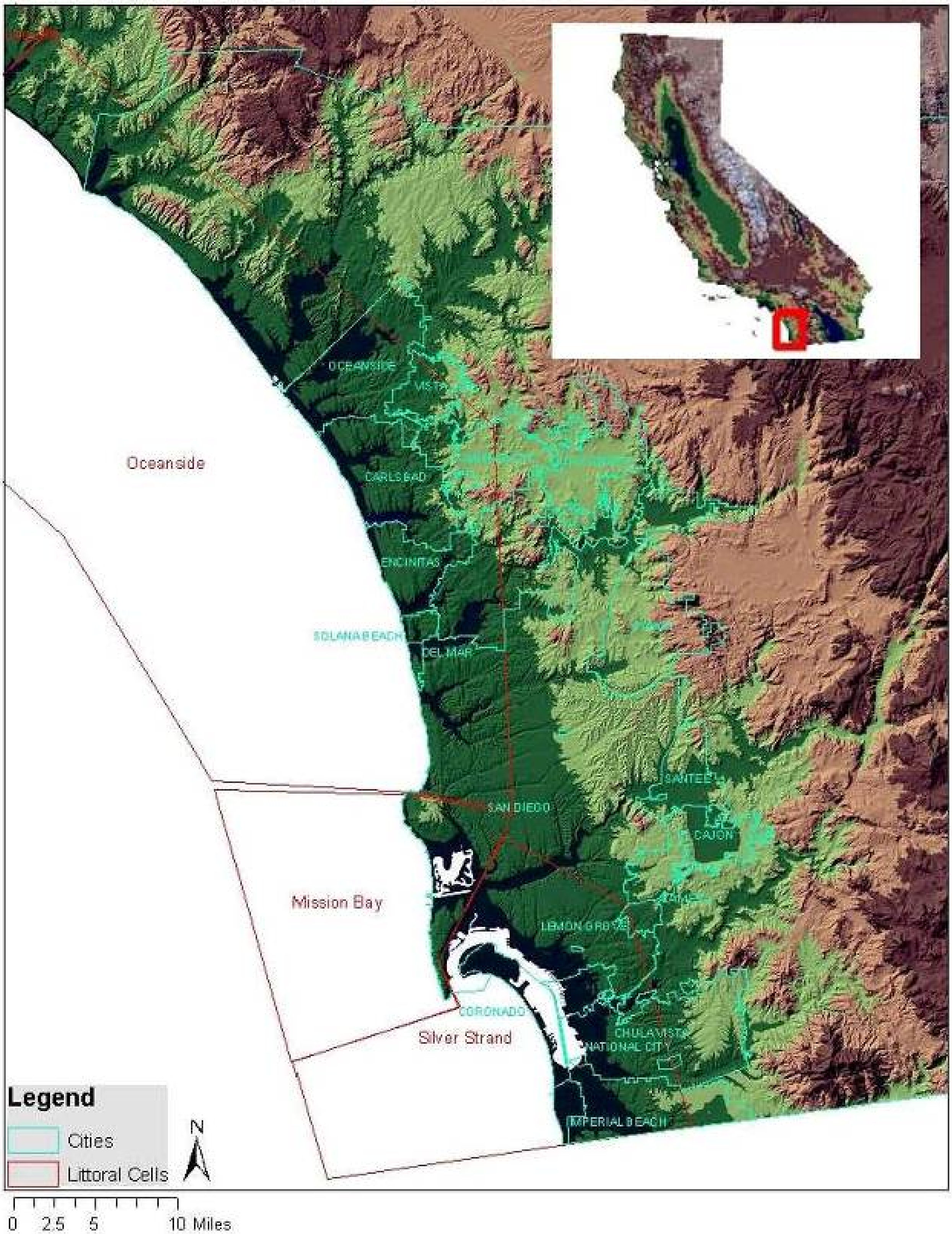
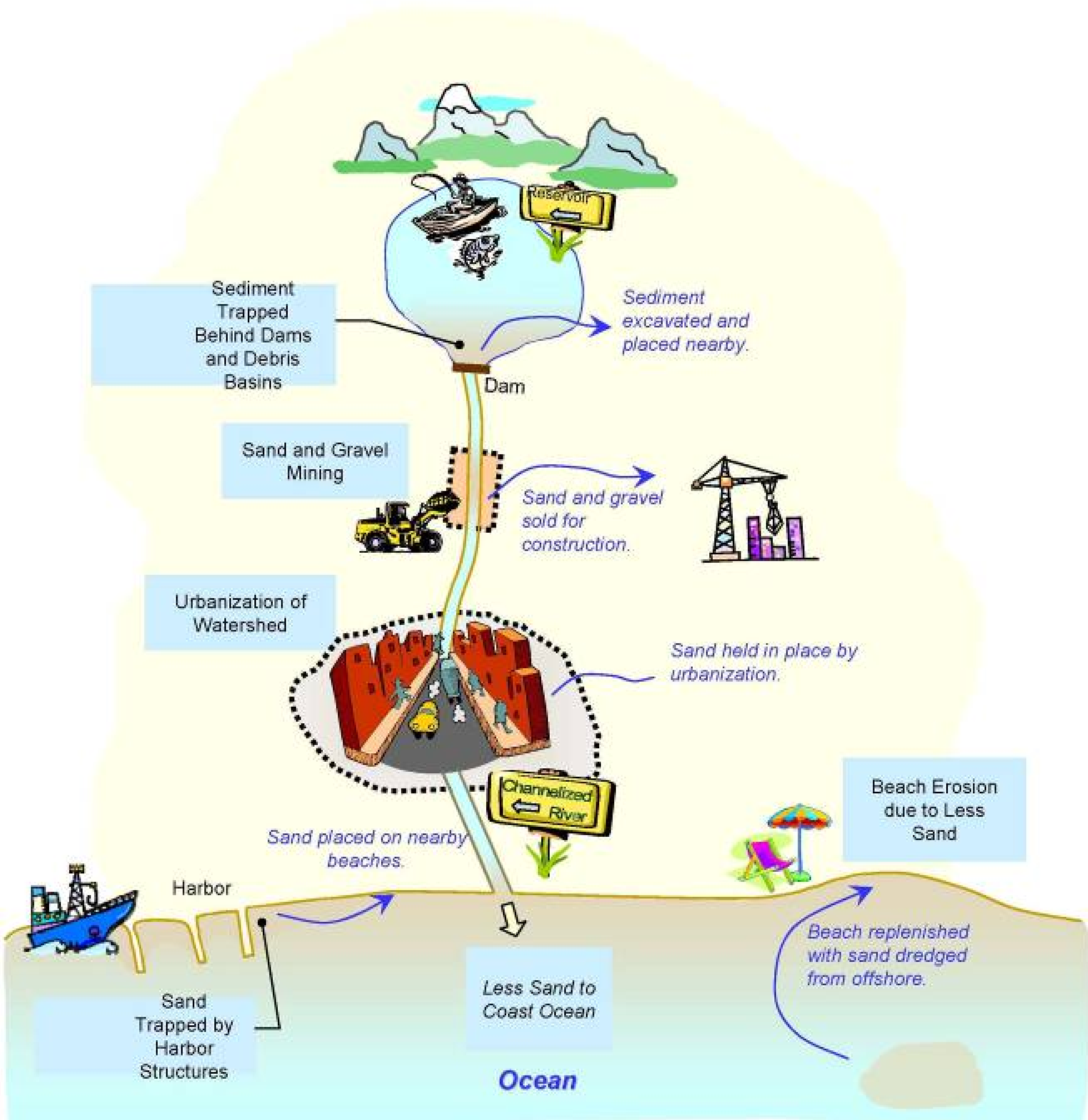
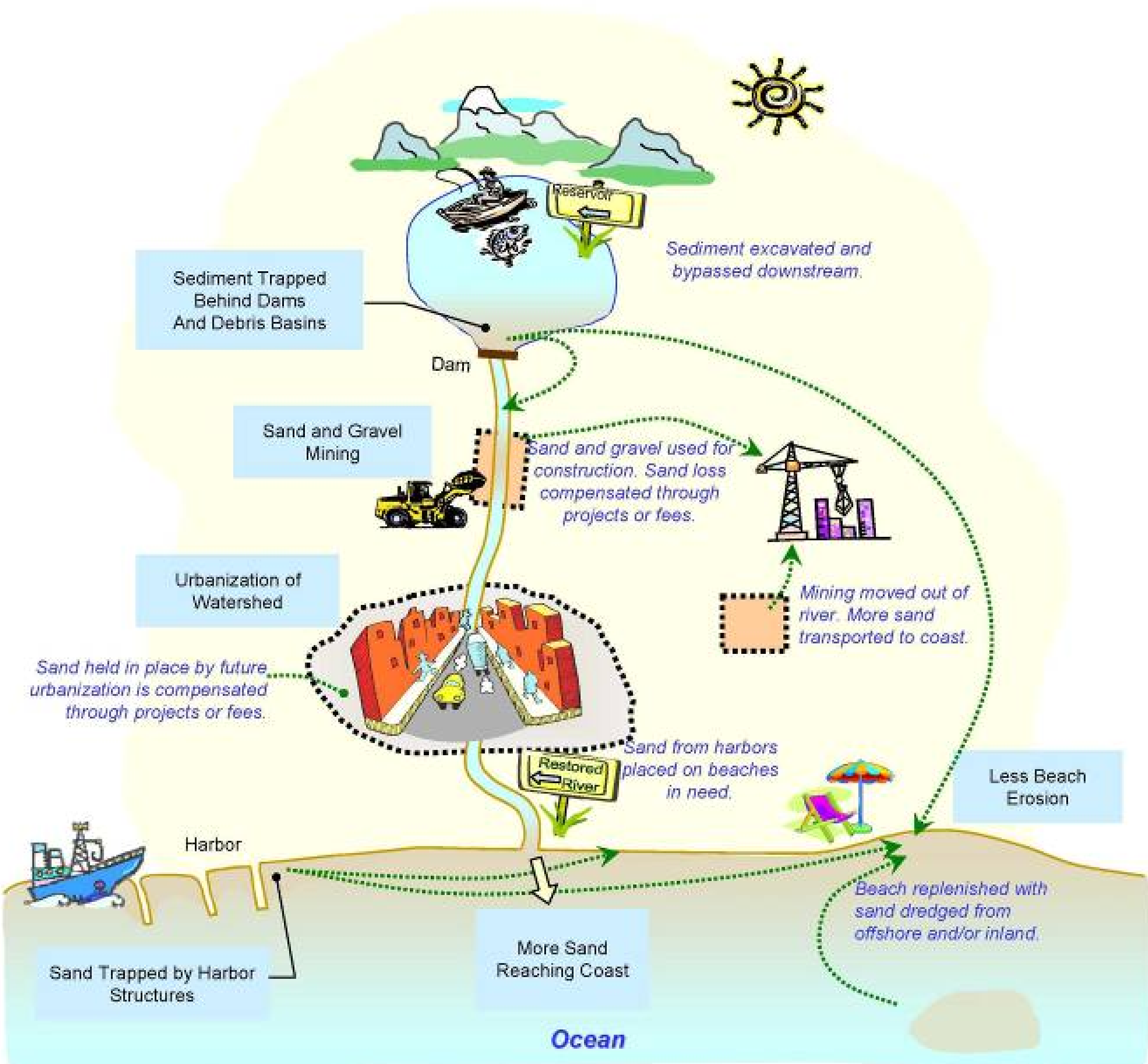


Figure 1 – The San Diego Coastal RSM Plan Region



Source: Sediment Management Plan Brochure on the CSMW Website 2008

Figure 2 – Existing Sediment Management Practices



Source: Sediment Management Plan Brochure on the CSMW Website 2008

Figure 3 – Examples of Proactive Sediment Management

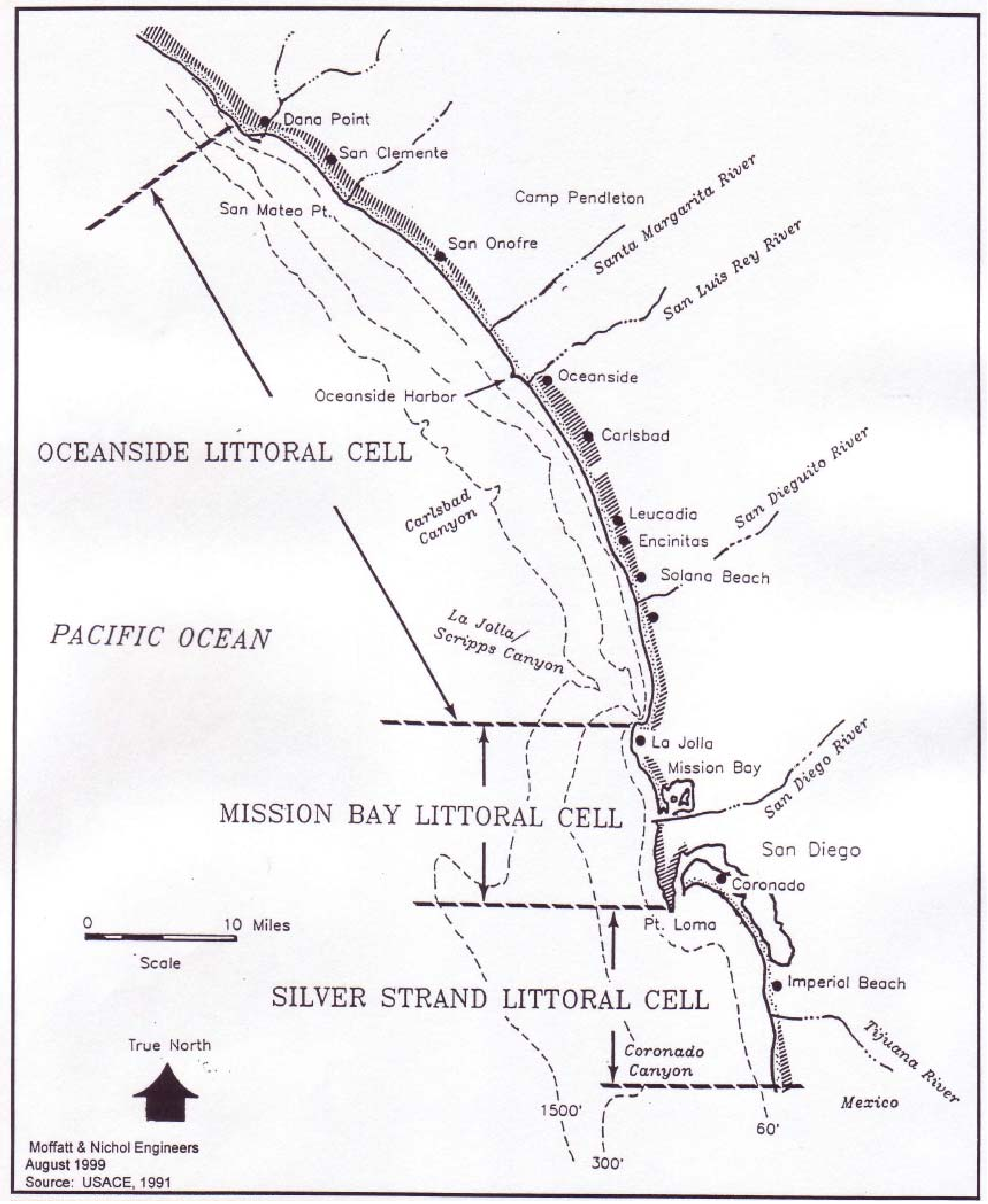


Figure 4 – Littoral Cells within San Diego County

1.1.2
Sediment Deficits and RSM Solutions

San Diego County coastal areas experience sediment deficits from effects of Oceanside Harbor, upstream flood control works, sediment detention basins, urban development, coastal bluff stabilization measures, lagoon and harbor sand trapping, and active erosion. Deficits are unequal in the region and occur mainly at San Diego North County and South County (Imperial Beach). The specific condition of the region's beaches and nourishment quantities needed to remedy the deficits according to the Shoreline Preservation Strategy (SANDAG 1993) are shown in the table below.

Table 1 - Coastal Sediment Deficits within 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 SANDAG RBSP I project showed a discernible "life span" of the 2.1 million cubic yard project to be approximately four years. The monitors indicate that after four years the widened beaches had reverted back to their narrower pre-project condition at year five (personal communication, Greg Hearon, Coastal Frontiers 2008). This observation generally indicates that a dispersion/loss rate of approximately 400,000 cubic yards of sand per year occurred from the region under recent conditions (roughly subdivided into 350,000 cubic yards per year from North County and 50,000 cubic yards per year from South County). No losses were detected from Central County beaches (Ocean, Mission, and Pacific Beaches). These losses are consistent in magnitude with the maintenance renourishment rates recommended by SANDAG in the SPS (1993).

Regional sediment management may solve the problem of insufficient sediment delivery to the coast, and allow more to move along the coast. Surplus sandy sediment at upland and coastal locations throughout the County is a burden to owners. These materials and those at offshore deposits can serve to nourish denuded beaches as a public benefit. Adding sediment to the coast that is presently trapped upstream and/or upcoast, or sequestered in offshore and terrestrial sand deposits may be effective for offsetting existing sediment losses to the coastal zone. Removal of existing surplus sediment deposits upstream, upcoast, offshore, and within terrestrial formations can also benefit those areas by restoring site functions if the sediment deposition is undesirable and not beneficial.

Future nourishment targets should at least equal loss rates, but should also be sufficient to result in gains. 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 structural sand retention), assuming no increase in the existing sediment loss rate occurs. This rate should therefore serve as the target renourishment guideline for future inputs to the region. Artificial structural sand retention would reduce that target amount, but the magnitude of the reduction is not yet defined.

1.1.3 Coordination

Coordination is required among owners of surplus sandy sediment and areas in need of nourishment to implement the management process. Existing management plans and projects that can be used to improve sediment management include the:

- Shoreline Preservation Strategy by SANDAG;
- SCOUP Plans I and II by SANDAG, Coastal Sediment Management Workgroup (CSMW), Department of Boating and Waterways (DBW), and the participating coastal Cities of Oceanside, Encinitas, Solana Beach, Coronado, and Imperial Beach;
- California Sediment Management Plan by the CSMW;
- Opportunistic Beach Fill Programs by participating coastal Cities derived from SCOUP Plans;
- Regional General Permit 67 by the USACE;
- California Coastal Act by the Coastal Commission;
- Monitoring and Observation Programs by Scripps Institution of Oceanography (SIO);
- SANDAG Regional Shoreline Monitoring Program; and
- Monitoring by SANDAG and local municipalities after implementation of beach nourishment projects.

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, the coastal Cities, and local stakeholders (local Watershed Planning Groups, Scripps Institution of Oceanography, Lobster Fisherman, the Surfrider Foundation, Homeowner Groups, and City Beach Erosion Committees).

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, and technical advisory members of appropriate resource agencies, stakeholder groups, and 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 can occur at this working group setting.

1.1.4
Impediments

Impediments to regional sediment management exist that need to be considered. Such impediments can include existing legislation, government policies, activities of stakeholder groups, economic challenges of projects, and possibly others. These types of potential road blocks can be anticipated and potentially avoided or modified to enable regional sediment management for the greater good. More information regarding impediments to this concept is presented in a subsequent section of this Coastal RSM 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 sediment 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 SANDAG and in coordination with the CSMW to:

- Restore and maintain coastal beaches and other critical areas of sediment deficit;
- Reduce the proliferation of protective shoreline structures;
- Sustain economics, recreation, and tourism;
- Enhance public safety and access; and
- Restore coastal sandy habitats throughout the region.

As such, development of the 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 sediment within the region.

1.2.2
Adoption of the Plan

The intent of preparing this Coastal RSM Plan is for its ultimate adoption by SANDAG as part of its mission. The plan will potentially guide all future actions related to projects in the coastal zone and potentially beyond. 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 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 development of the Regional Comprehensive Plan (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 our 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 under funded: habitat preservation, beach sand replenishment and storm water management. Generally speaking, these three infrastructure areas do not have a system in place to address their needs (funding) and prioritize their expenditures. For this reason, the IRIS and RCP recommended that SANDAG take a role in initiating a process that develops a system to address 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 and/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.” In order to meet this commitment, the SANDAG Board of Directors should begin to discuss various funding alternatives that are reasonable to fulfill this obligation.

The Board began discussing strategies to meet this obligation in January 2007. The Board directed 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 and water quality 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 upstream development. The SANDAG Board has recognized the importance of developing a long-term funding program for beach sand replenishment with the adoption of the Shoreline Preservation Strategy 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 sand retention over the next 40 years.

It is necessary to consider whether it is the best use of public funds to determine if the Coastal RSM Plan is consistent with SANDAG objectives. Funding needed to implement nourishment and beach restoration includes project costs for planning, engineering, construction, and monitoring and possible mitigation. Funds should be sufficient to serve as matching funds for state and federal support. Additional costs often exist to enable an upland development project with surplus sandy sediment to reuse it for beach nourishment. These incremental and additional costs also comprise a real cost to the region that must be considered.

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). Rates vary between regions, and estimates applied also vary between agencies. The effect of sea level rise will cause further narrowing of beaches as water levels rise relative to land elevations.

Coastal sediments are basically sequestered offshore as ocean water levels rise relative to land. Therefore, coastal sediment losses and narrowing of beaches will accelerate into the future if no action is taken to counter these effects. Regional sediment management is one mechanism to counter the effects of sea level rise and maintain functional sandy beach areas. Restoring beaches (with sand 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.

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: (1) The upper part of the active beach above the normal reach of the tides 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, extend across the beach, and seaward into the nearshore zone to the closure depth (see below).
- 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 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 coarse 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 of the 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 all sediment transport is bounded. In theory, it has zero longshore sediment transport beyond its updrift and downdrift boundaries. It will likely contain sand sources (rivers), storage areas (beaches), and sinks (canyons).
- Nearshore: The seafloor along a coast between the closure depth (typically near -30 feet MLLW) and Mean Lower Low Water (MLLW).
- Offshore: That part of the seabed below the depth of closure.

- Opportunistic Sand - Surplus sand from various source materials, including inland construction, development projects, and public works in the region, dredging of harbors or wetlands, etc.
- 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.

Acronyms used in the report include:

- CCC – California Coastal Commission;
- CDFG – California Department of Fish and Game;
- CEQA – California Environmental Quality Act;
- CSLC – California State Lands Commission;
- CSMW – Coastal Sediment Management Workgroup;
- DBW - Department of Boating & Waterways;
- 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;
- USACE – U.S. Army Corps of Engineers;
- USEPA – U.S. Environmental Protection Agency; and
- USFWS – U.S. Fish and Wildlife Service.

1.5 Disclaimer

Funding for this project was provided to SANDAG by a California Department of Boating and Waterways grant as part 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 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.

This Coastal RSM Plan does not preclude the study and implementation of other erosion control alternatives such as perched beaches, groins, dynamic revetments, breakwaters, submerged reefs and breakwaters, headland enhancement, etc.

2.0

SCOPE OF WORK

2.1 Develop the Coastal RSM Plan and RSM Tools

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

1. Compile Relevant Coastal References and Sediment Information (see Appendix A);
2. Locate Critical Coastal Erosion Areas, now referred to as Beach Erosion Concern Areas (BECAs), within the Region;
3. Identify Potential Sediment Sources Including Harbors, Wetlands, Flood Control Sites, Offshore Areas, and Construction and Highway Projects;
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 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. 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 to generate practical and feasible ideas for recommending a governance structure. Assisting with governance involves 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; and

4. Assess any unique additional local issues that could affect the Coastal RSM Plan.

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 sediment 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);
3. Matrices and maps of sediment sources;
4. Matrices of available sediment quality information of sources and receiver sites, with georeferenced information for the CSMW database;
5. Possible concepts for innovative nourishment technologies;
6. Quantified economic feasibility of sediment 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 and/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 U.S. Fish & Wildlife Service (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 sediment 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. Possible identification of cooperative agreements needed within the region for the plan and impediments to plan implementation;
15. Possible scenarios/concepts of sediment 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

Coastal processes determine the existing patterns of sediment transport, erosion, and deposition along the coast. As such, they are important to understand for formulation of the Coastal RSM Plan. A brief description of the region's coastal processes is provided for context in considering the Plan. Coastal processes addressed herein include sediment budgets, longshore sediment transport rates, and wave conditions. 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 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 (Moffatt & Nichol 2000b), from the California Department of Boating and Waterways and San Diego Association of Governments (DBW/SANDAG 1994), and from the more recent study done by Patsch and Griggs (2006).

3.1 Sediment Budgets and Longshore Sediment Transport Rates

The sediment budget approach was developed to understand coastal processes and shoreline change. The sediment budget conceptually accounts for inflows (sources), outflows (sinks), and storage of sediment within a 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 bypasses submarine canyons and can 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 by aeolian losses to dunes, cross-shore transport offshore, or by channeling of the sediment into a deep basin via a submarine canyon and on to the continental shelf. Sediment sources to a cell include beaches, rivers, bluffs, offshore deposits, and artificial nourishment. Sediment sinks include submarine canyons, offshore losses during storms or from deflection by structures, inland losses via wind transport, lagoon mouths and harbors. Beaches and the nearshore zone represent storage areas within a littoral cell. Sand either moves through a littoral cell along the beach and/or nearshore zone from source to sink, and is stored at beaches within the cell. The sediment budget is either in balance with stable beaches, in a surplus with growing beaches, or in a deficit with narrowing beaches.

Sediment budget information clarifies whether a beach is 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.

3.1.1 Oceanside Littoral Cell

- **The Sediment Budget**

  The Oceanside Littoral Cell extends from Dana Point to Point La Jolla as shown in Figure 4. The San Diego Region Coastal RSM Plan project area occupies most of the southern subcell of this littoral cell, from approximately Oceanside Harbor to La Jolla. The southern portion of this cell constitutes sand placement areas for this Plan as the Harbor represents an effective barrier to sediment transport from the northern portion to southern portion of the cell. 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 in the early 1990s by DBW/SANDAG (1994).

- **Longshore Sediment Transport Rates**

  Longshore sediment transport 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 transport rate to the north and the south 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.

  Several previous estimates exist for longshore sediment transport in the Oceanside Littoral Cell that are presented by the 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 0 cubic yards per year to 550,000 cubic yards per year to the south, with the average being approximately 275,000 cubic yards per year to the south.

  Minor reversals in the dominant sediment transport direction occur seasonally, and sometimes extend over longer periods such as 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 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 wave events than summer/fall conditions and so it tends to be the dominant process over the long-term. The long-term net sediment transport direction is considered by most researchers to be to the south.

3.1.2
Mission Bay Littoral Cell

- **Sediment Budget**

This cell extends from Point La Jolla to Point Loma as shown in Figure 4, and is subdivided into subareas. The subareas of the cell relevant to this study includes 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 reach is in a deficit of 10,000 cubic yards per year, and the Ocean Beach reach is in a deficit of 7,000 cubic yards per year. Per Patch and Griggs (2006), the deficit for the entire Mission Bay littoral cell, including both beaches, is almost 40,000 cubic yards per year.

- **Longshore Sediment Transport Rates**

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 entire littoral cell extends from Point Loma to the Coronado Canyon in Mexico. Relevant compartments of this cell relevant to this Coastal RSM Plan are the one from the international border to the Tijuana River (Tijuana River Delta compartment) and another from the Tijuana River to the San Diego Bay entrance channel (the Strand compartment). Both South County littoral cell compartments are in a sediment deficit. The deficits range from 65,000 cubic yards per year in the Tijuana River Delta compartment to 40,000 cubic yards per year in the Strand compartment (USACE 1990 and 1991).

At the Tijuana River compartment, 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 compartment, average yearly sediment inflows include 25,000 cubic yards per year from artificial nourishment, 65,000 cubic yards per year alongshore from the compartment to the south, 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 to the next compartment north along the Silver Strand (USACE 1990 and 1991). Patsch and Griggs (2006) indicate that presently a balance exists in this cell due to beneficial effects of beach nourishment. Without nourishment, the cell would be in a deficit of approximately 41,000 cubic yards per year. As nourishment in this cell has not occurred recently to any great extent, it is reasonable to conclude that the cell is a deficit condition at this time.

- **Longshore Sediment Transport Rates**

  Generally along both compartments, gross sediment transport is 740,000 cubic yards per year and net longshore sediment transport is to the north from between 120,000 and 200,000 cubic yards per year.

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

Ocean waves off the coast of Southern California can be classified into four main categories: northern hemisphere swell, tropical swell, southern hemisphere swell, and seas generated by local winds as described below:

- Northern hemisphere swell represents the category of 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 storm events, 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 storms that have entered the Southern California area, 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 2008; Moffatt & Nichol Engineers 1988 and 2000b). The most northern window is from 310 degrees to 280 degrees relative to true north (0 degrees) 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 is between azimuths 290 and 250 degrees. The Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) and Santa Catalina Island provide some sheltering from the higher waves associated with these two windows, depending on the approach direction. The other major exposure window opens to the south between 250 and 150 degrees, allowing swell from southern hemisphere storms and 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 from the north and outputs from the littoral cell to the south.

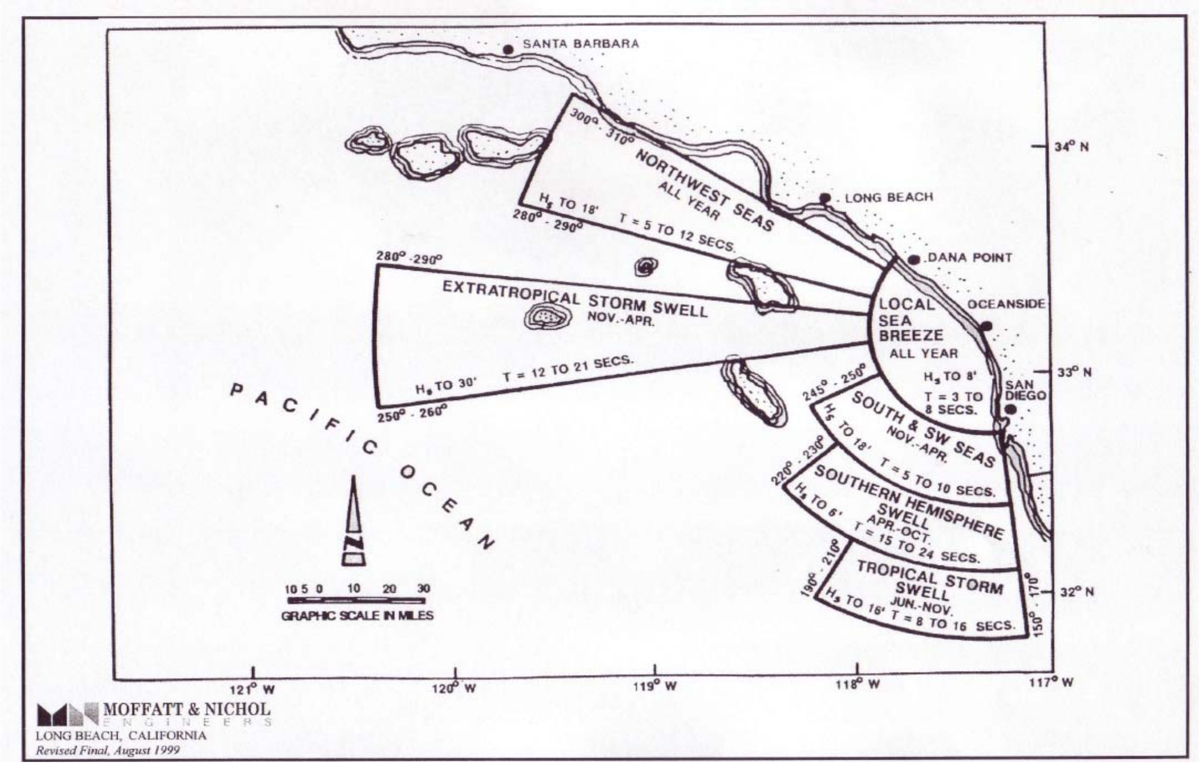


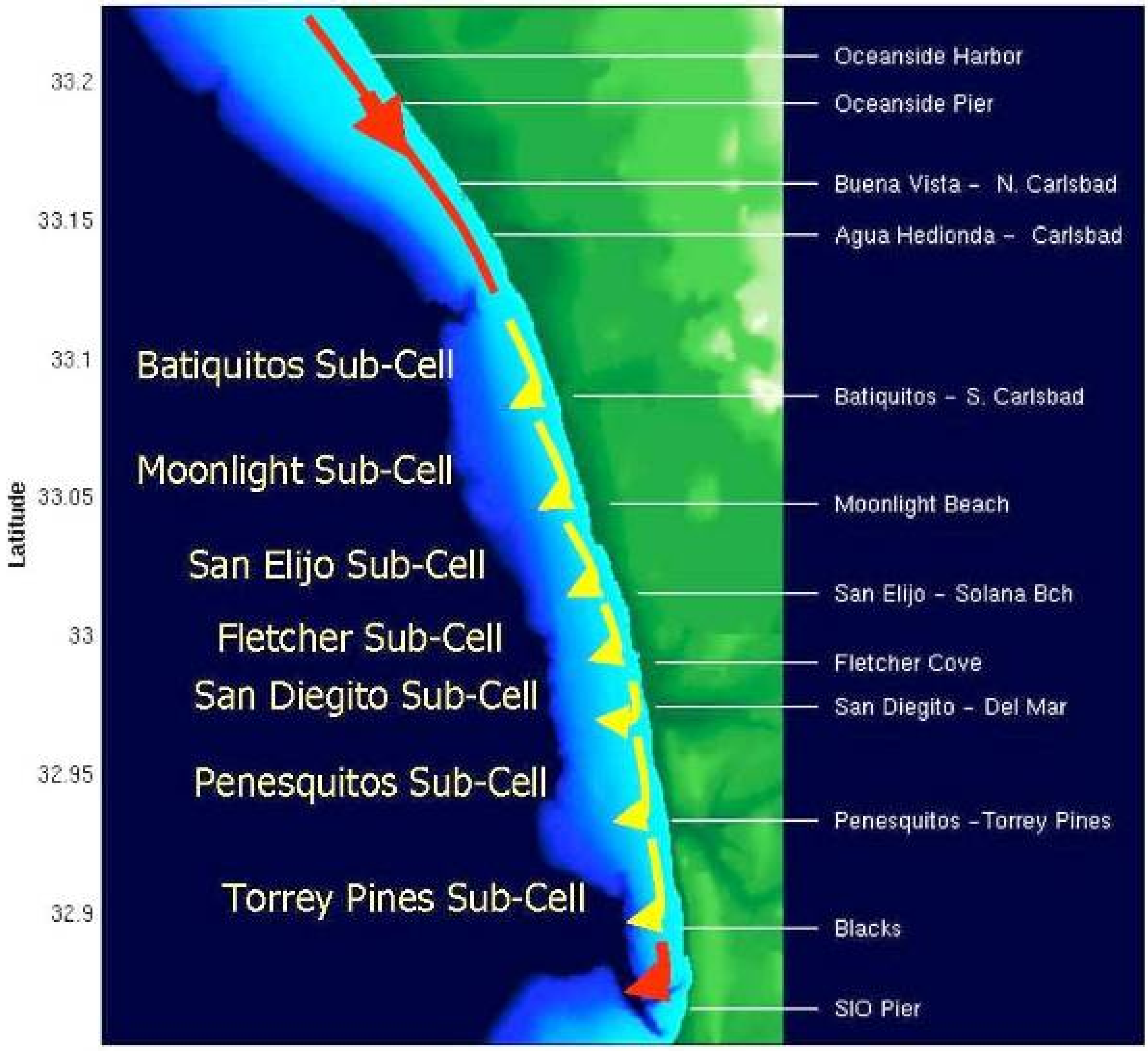
Figure 5 – Wave Exposure Diagram

3.3 Theoretical Subcells Within the San Diego North County Region

Scripps Institution of Oceanography (SIO) is researching hypothesized sediment transport subcells within the southern Oceanside Littoral Cell as part of the Southern California Beach Processes Study. These "lagoon subcells" act as areas where longshore sediment transport patterns vary from alongshore to more cross-shore resulting in sand loss from the beach. Relic bathymetric features may cause refraction of waves incoming toward shore that modifies longshore currents sufficiently to interrupt longshore sediment transport (O'Reilly, personal communication, 2008).

The effect is that longshore sediment transport is highest between lagoon locations and inshore of historic kelp beds, such as at Tamarack, South Carlsbad, Leucadia, North Cardiff Beach, south Del Mar, and south Torrey Pines. Sand placed at these areas should remain relatively close to shore and move downcoast to the south over time.

In contrast, offshore transport of sand is highest immediately off or just downcoast of lagoon locations causing beach erosion hot spots. Examples of these sites are North Carlsbad, Terramar Point, Batiquitos Beach, Moonlight Beach, South Cardiff Beach, Fletcher Cove, north Del Mar, and North Torrey Pines Beach. Sand placed near these sites may more primarily offshore and be lost to the system, rather than moving alongshore. An example of this condition is shown in **Figure 6.**



Source: Scripps Institution of Oceanography, Bill O'Reilly 2008

Figure 6 – Wave-Driven Lagoon Sub-Cells

This work is still ongoing and will be published in the near future. It bears on the recommended placement sites for sand. This Coastal RSM Plan presents various proposed sand placement sites throughout the region, including some that may be affected by this offshore sand transport condition hypothesized by SIO. The RSM receiver sites presented in this Plan are initial proposals that can be modified over time as adaptive management while the SIO theory is formalized and monitoring occurs. SIO implemented an outreach program for CDIP called Model Predicted Systems (MOPS) that are continuously monitored beach sites. The MOPS system shows predicted versus actual beach conditions, and is ideal to use as an adaptive management tool for this Coastal RSM Plan. This system will be available to the public in the future on the internet, but is not yet available for public use.

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, 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, with notable exceptions being localized and short-lived accretion due to nourishment activities. The beaches and cliffs have eroded for thousands of years by ocean waves and rising sea levels. 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, water quality control devices, removal of sand and gravel through mining operations, harbor construction, increased wave energy since the late 1970's, and the creation of impervious surfaces. 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. 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 beachfill, 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 actively documented by the federal, state, regional, and local governments. The CSMW focuses on addressing statewide sediment management and has systematically inventoried areas of erosion throughout coastal California, including those of local concern in selected areas of the coast. SANDAG is assessing the local region experiencing the erosion, 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 beach erosion concern areas (BECAs), including those in the San Diego region shown in **Figure 7.** The list of BECAs in San Diego County includes those below. These sites have been identified through various data sources including local surveys done by Cities and/or SANDAG as part of monitoring programs, extensive analyses by the USACE (1990 and 1991), and analyses performed by DBW/SANDAG (1994). Recent evaluation of erosion areas was performed by SANDAG and the CSMW as part of the Sand Compatibility and Opportunistic Use Program (SCOUP) (Moffatt & Nichol 2006). The SCOUP program evaluated potential erosion areas and recommended sand placement sites for opportunistic sand (defined subsequently in this document). The sites identified by the various efforts listed above comprise the list shown in Table 2.

Table 2 – Beach Erosion Concern Areas Designated by the CSMW

San Diego	North County San Diego/South Oceanside	Survey; USACE; CRSMP
San Diego	Carlsbad City Beach/North Carlsbad	CRSMP
San Diego	Agua Hedionda/Encinas	CRSMP
San Diego	South Carlsbad State Beach/Encinas Creek	Survey; CRSMP
San Diego	Batiquitos Lagoon Beach	CRSMP
San Diego	Encinitas/Leucadia Beach	CRSMP
San Diego	Encinitas/Moonlight State Beach	USACE; CRSMP
San Diego	Cardiff State Beach/San Elijo Lagoon Beach	CRSMP
San Diego	Solana Beach/Fletcher Cove	USACE; CRSMP
San Diego	Del Mar City Beach/San Dieguito Lagoon Beach	CRSMP
San Diego	Torrey Pines State Beach	CRSMP
San Diego	Mission Beach	CRSMP
San Diego	Ocean Beach (San Diego)	CRSMP
San Diego	Coronado	CRSMP
San Diego	Imperial Beach	USACE; CRSMP
San Diego	Tijuana Estuary South Beach	CRSMP

Survey- Location identified in DBWs initial survey of erosion sites
USACE- Location under assessment for federal interest
CRSMP- Location identified within regions-specific Coastal RSM Plan
CSMW- Location identified by CSMW member as of concern

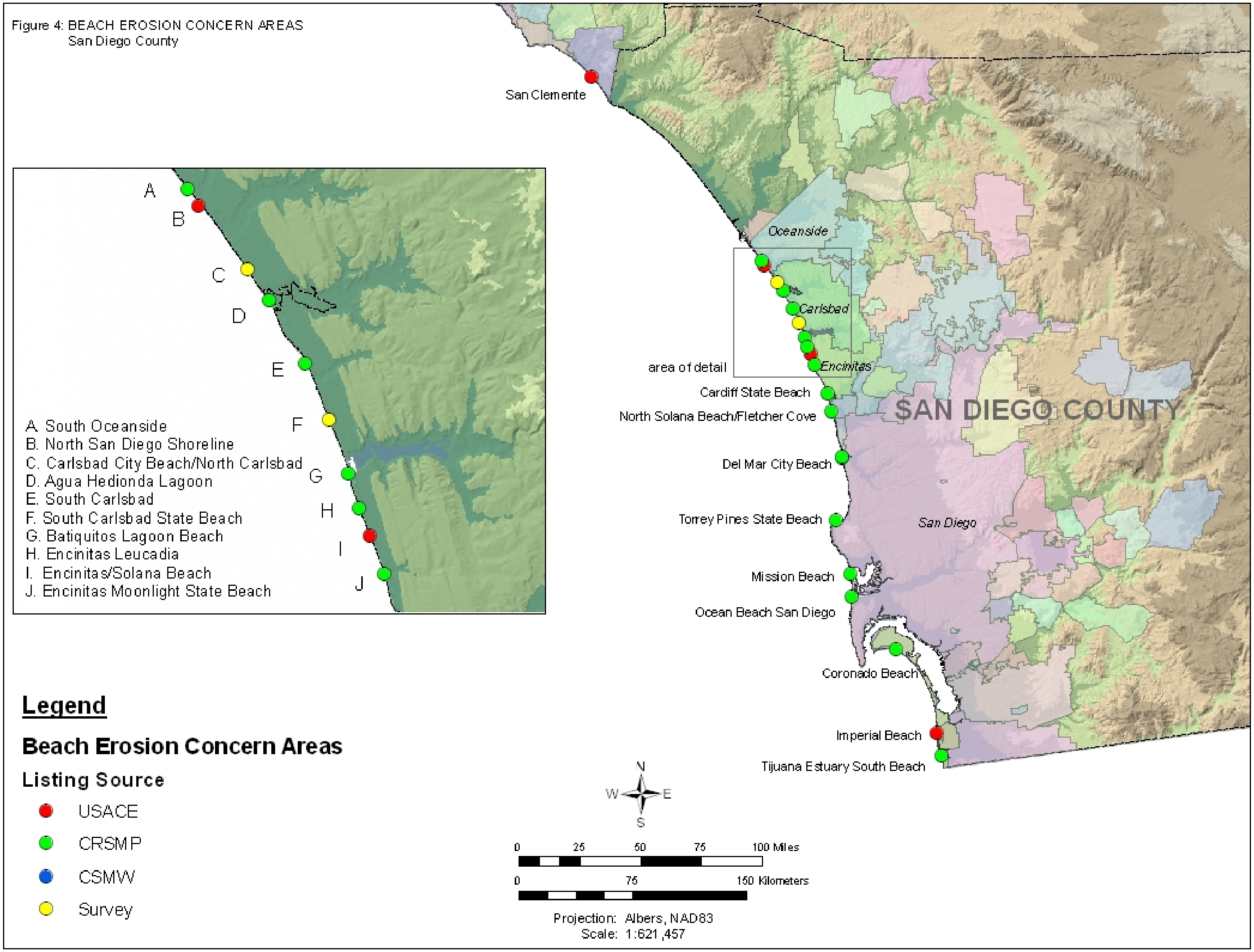
The three sites of Mission Beach, Ocean Beach, and Coronado on this list are less erosive then the others, but they do experience periodic problems during severe winter storm waves.

4.1.2
SANDAG Shoreline Erosion Problem Areas

SANDAG has identified "problem" coastal erosion areas in the SPS (1993) as shown in **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.

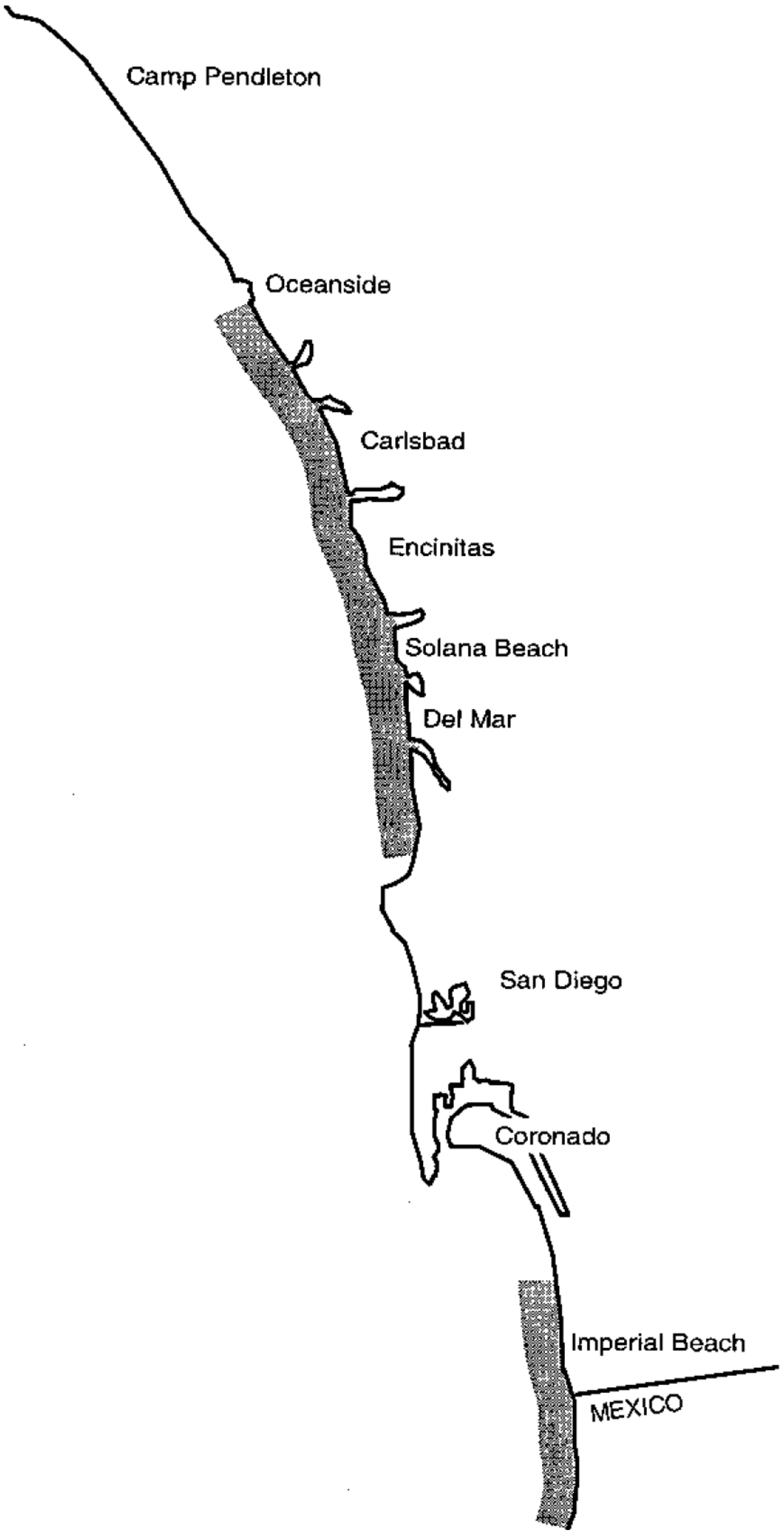
In North County, the entire reach of coast from Oceanside to La Jolla Shores is considered a problem area. There is a near-constant length of erosion problem throughout North County and it requires some sort of remediation in the opinion of SANDAG and its members. The condition of eroding coastal bluffs 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.

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



Source: CSMW 2008

Figure 7 – State of California Beach Erosion Concern Areas



Source: SANDAG Shoreline Preservation Strategy 1993

Figure 8 – SANDAG Shoreline Erosion Concern Areas

4.2 Beach Profiles

Beach conditions have historically been recorded in the form of beach profiles, measured as 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 useful for planning and designs.

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 indicate 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 little variance because the inland geology is fairly uniform throughout the regions watersheds, and wave conditions and energy imposed on the profile 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. Coastal Frontiers provides them in the 2007 monitoring report to SANDAG as shown in Table 3 below. The slopes of beach profiles out to the closure depth are similar for each site, with a slightly steeper slope in North County and 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 elevational lows in severe winters to elevational highs during quite periods and summer. Post-beach nourishment profiles are shown on the figures to depict their elevations after implementation of RBSP I.

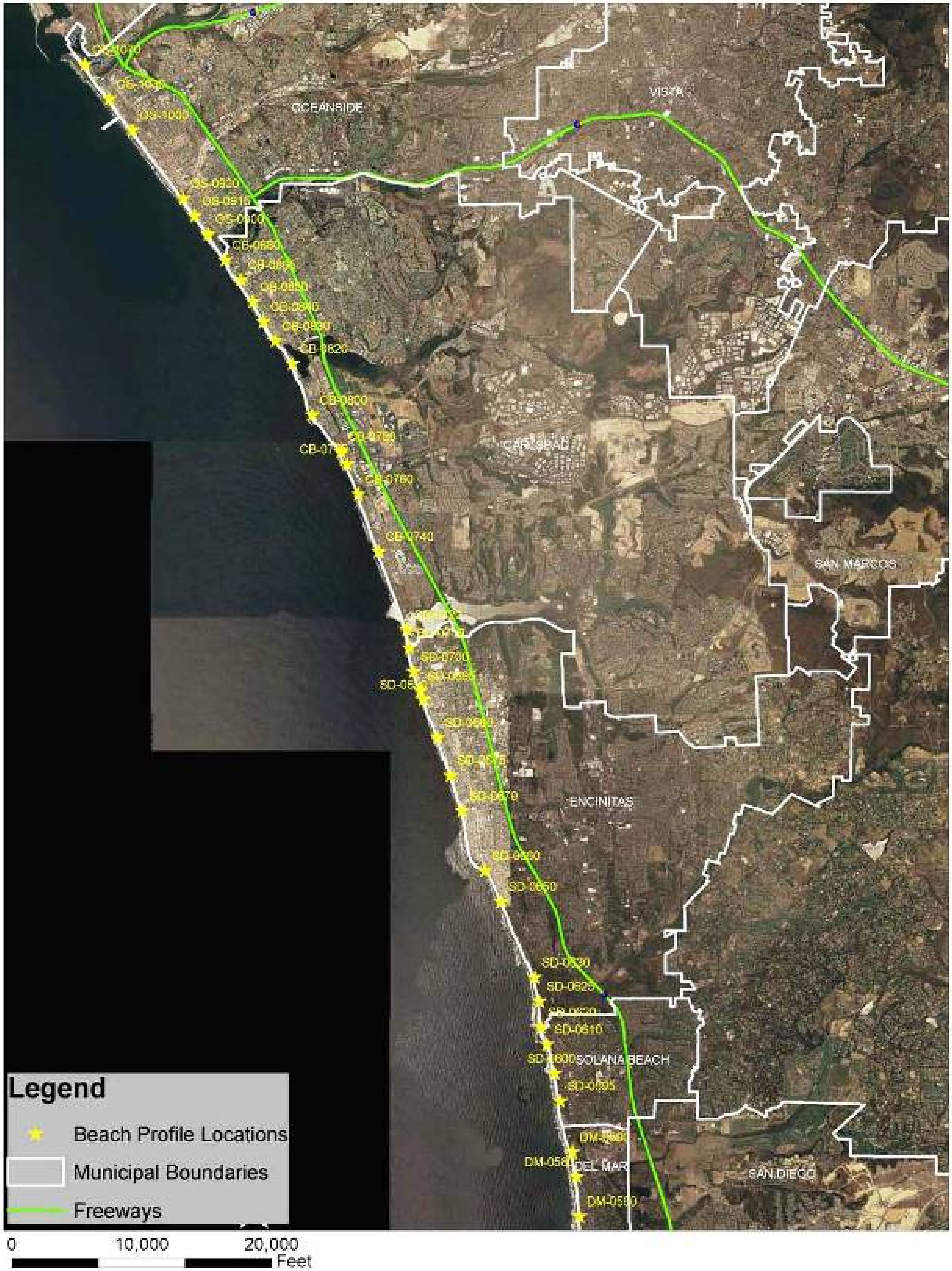
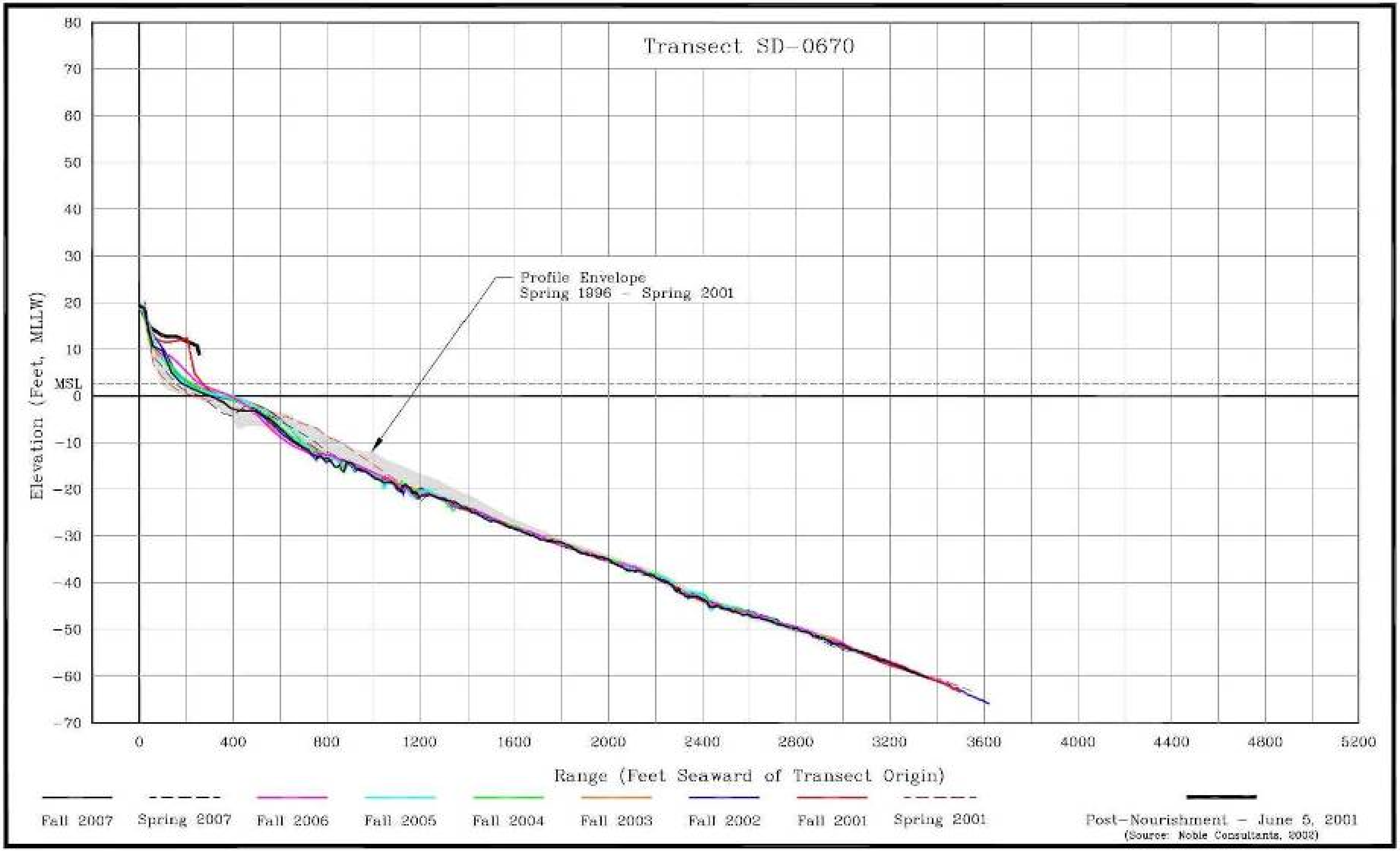


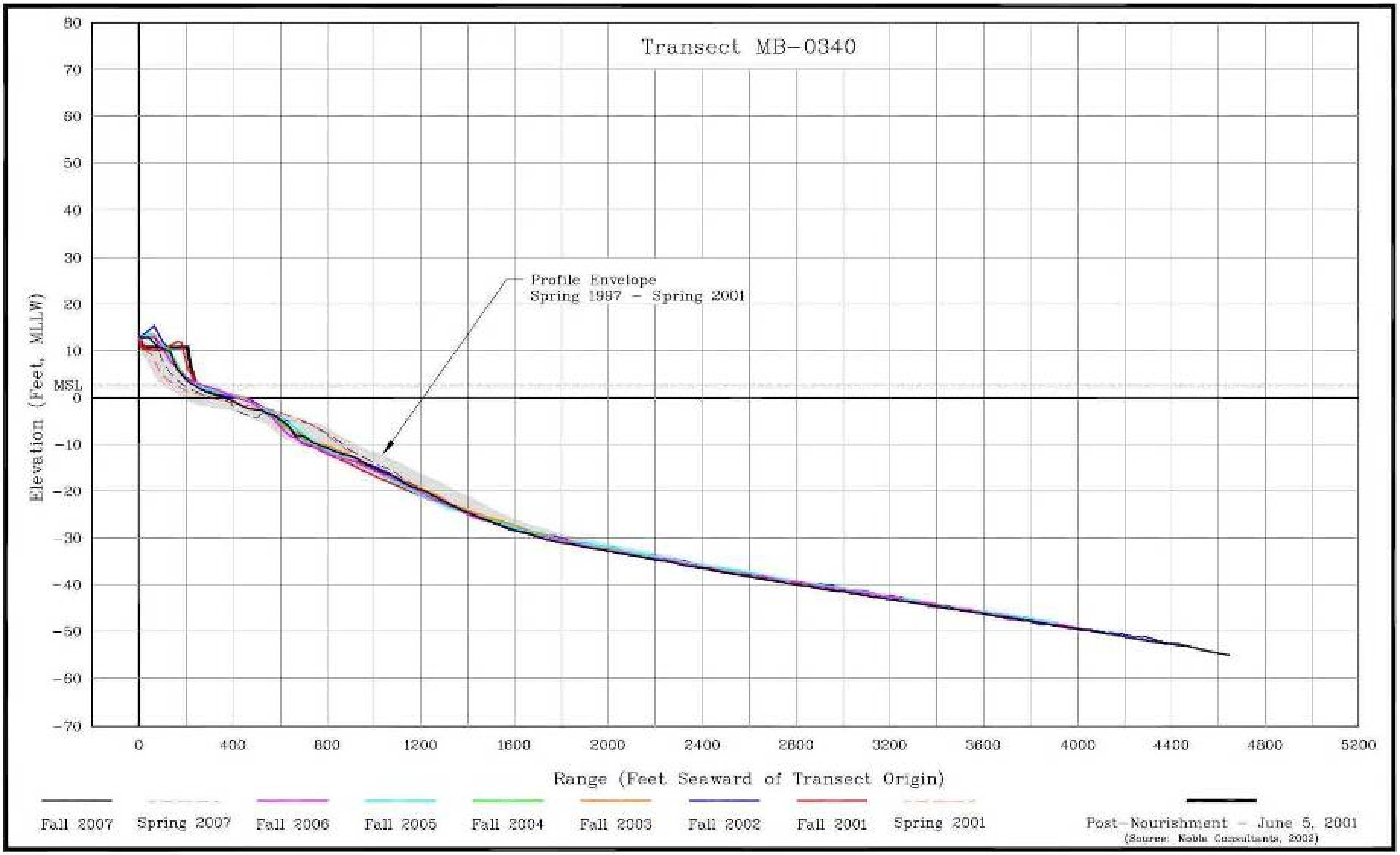
Figure 9 – Beach Profile Locations (North County)

Figure 10 – Beach Profile Locations (South County)



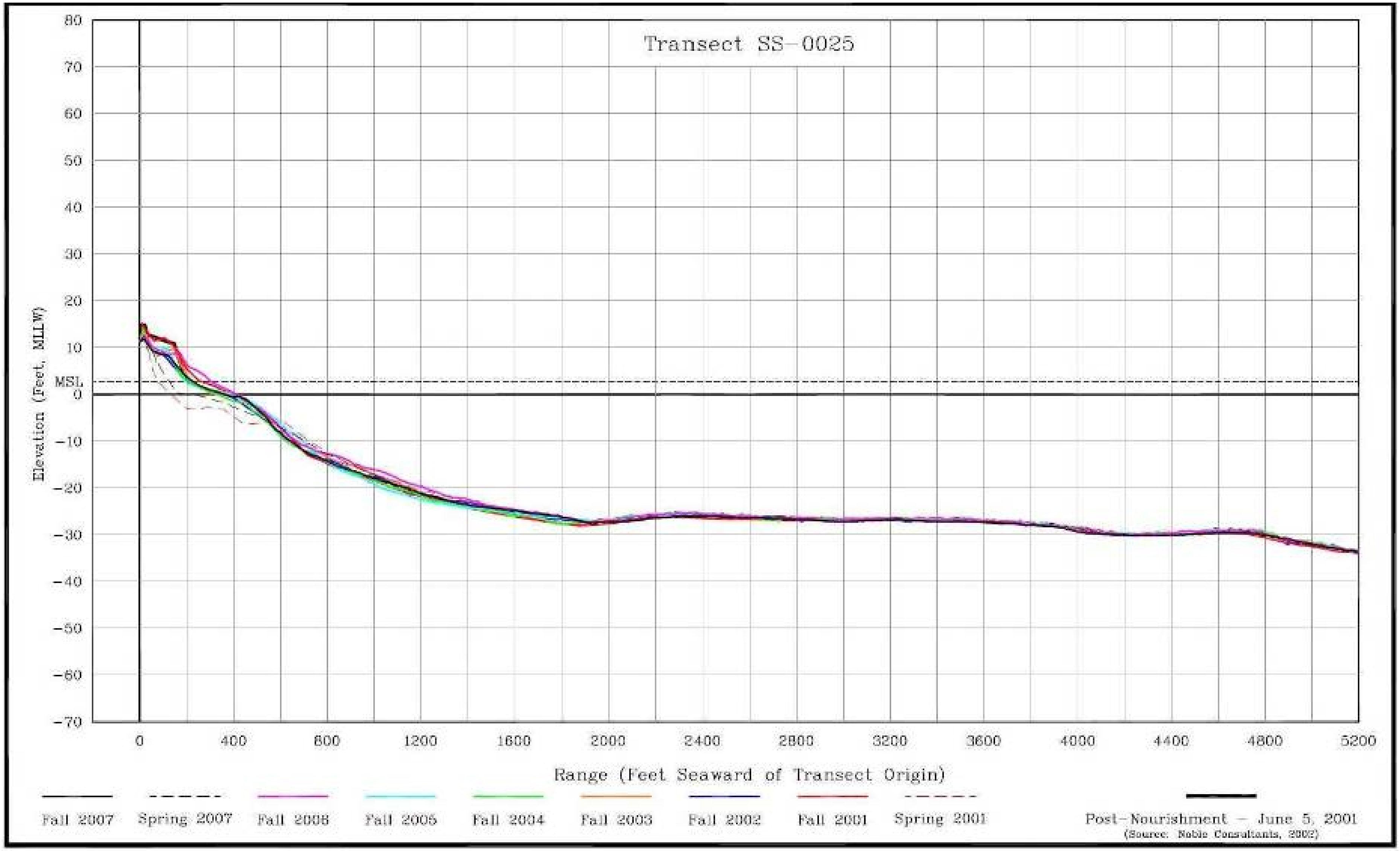
Source: Coastal Frontiers, 2008

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)

4.3 Existing Coastal Sediment Quality

Data of existing beach sediment quality were obtained for individual coastal Cities for opportunistic beach fill programs, and for SANDAG as part of the SCOUP I and SCOUP 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 within the San Diego region from that initial effort, resulting in SCOUP II. SCOUP II 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 done 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 and analyzed to identify the appropriate gradations to characterize nourishment material for each potential receiver site. Candidate beach fill material is assessed for suitability against the composite gradation envelope of the receiver beach. Composite gradation envelopes have been developed for seven receiver site locations throughout North and South County. Figures in Appendix C show grain size envelopes for Oceanside, Carlsbad, Encinitas, Solana Beach, Coronado, Imperial Beach, and at the beach at Border Field State Park near the Tijuana Estuary, respectively.

Most of the region's beach sand is fine to medium in grain size. Sand has grain size diameters ranging in size from 0.074 (very fine) to 4.0 millimeters (mm) (coarse). 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. North County beaches tend to possess slightly coarser sand than South County beaches, but the difference is minor and they are still very similar to each other.

Previous data were also collected by the USACE (1984) and Woodward-Clyde Consultants (1998). Their data from the 1980s and early 1990s show that the mean grain size of native beach sand at these receiver beaches vary, but tend to center on approximately 0.22 millimeters (mm) which is considered fine-sized sand.

The region's beaches may have experienced sediment input over the last 20 years that has resulted in increased grain sizes on average. The more recent data may reflect effects of SANDAG's RBSP I where 2.1 million cubic yards of relatively coarser grained sand from some offshore source sites was dredged and placed on area beaches. That project may have had the beneficial effect of increasing median sand grain size on the region's beaches. Coarser sand grains tend to remain on the beach longer than finer-grained sands.

4.3.1 Grain Size Homogeneity

Homogeneity in material grain size means the grain sizes are very similar with little range or difference in sizes. Less homogeneous gradation refers to grain sizes that range very broadly from very fine to very coarse. Sand on the region's beaches is fairly narrow in the range of grain sizes. The exceptions are at beaches with cobbles in addition to sand, such as at each beach during the winter season, except at Coronado, Mission Beach and Ocean Beach.

Grain size is an indirect indicator of potential chemistry. Sandy sediments have less ability to retain contaminants. The beaches are mainly composed of sand and therefore possess less potential 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 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. However, sand grain sizes range more broadly across the entire beach profile from the high dry beach (at an elevation of +10 feet above mean lower low water, or MLLW) out to the depth of closure (at an elevation of -30 feet below 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 -10 feet out to the depth of approximately -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 terrestrial 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 are typically darker colored than the receiving beach initially. When placed in the surf zone, the material is washed and reworked by waves resulting in sand very similar in appearance to the receiving beach. Color was addressed in the SCOUP Plan (Moffatt & Nichol 2006) developed for the first pilot project by requiring material from upland to be placed below the mean high tide line for tides and waves to naturally rework the sediment. This reworking process adequately distributes and disperses the sediment so source sand with 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 sand was placed over the white sand beach at Ponto Beach in Carlsbad, California (Sherman, et al. 1998). Permit agencies have informally indicated that the only criteria for color is to reasonably match the color of the receiving beach after reworking by waves for aesthetic reasons.

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 have localized occurrence along the coast. Within these coastal areas, biological resources 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 Protection Act (MLPA) was passed in 1998 by the California Legislature to ensure the conservation, restoration, and sustainable use of California's marine living resources. The MLMA requires that Fishery Management Plans (FMPs) form the primary basis for managing the state's marine fisheries. The California Department of Fish and Game (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).

The following sections summarize sensitive resource constraints (Section 4.4.2) including managed species (e.g., grunion, lobster) and impact considerations (Section 4.4.3).

4.4.2 Summary of Constraints

Figures 14 to **21** illustrate locations of rocky vegetated reefs, surfgrass, lagoons, and nesting and/or wintering areas of sensitive 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 may 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.

Several state-managed species of commercial and/or recreational importance are associated with hard bottom and/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 and/or subtidal habitats. For example, California grunion (*Leuresthes tenuis*) spawns on sandy beaches of suitable habitat quality in the region. Pismo clam (*Tivela stultorum*), which may occur in localized beds in sandy subtidal sediments and in the intertidal zone of some beaches.

Generally, sensitive habitats, sensitive species, and areas of concentration of state-managed species represent constraints for sediment 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 sediment management activities.

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

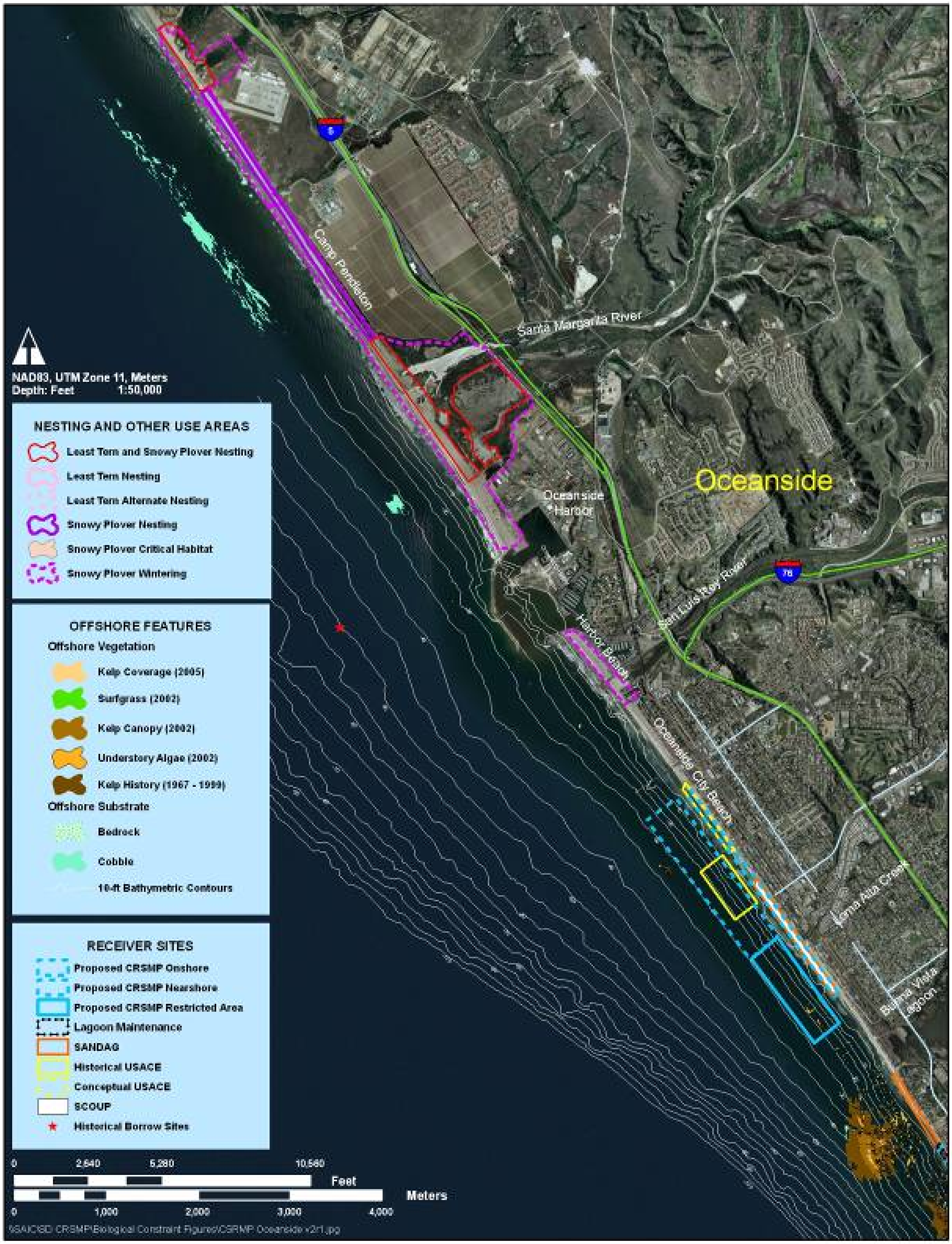


Figure 14 - Sensitive Biological Resource Areas in the Vicinity of Oceanside Sediment Management Areas

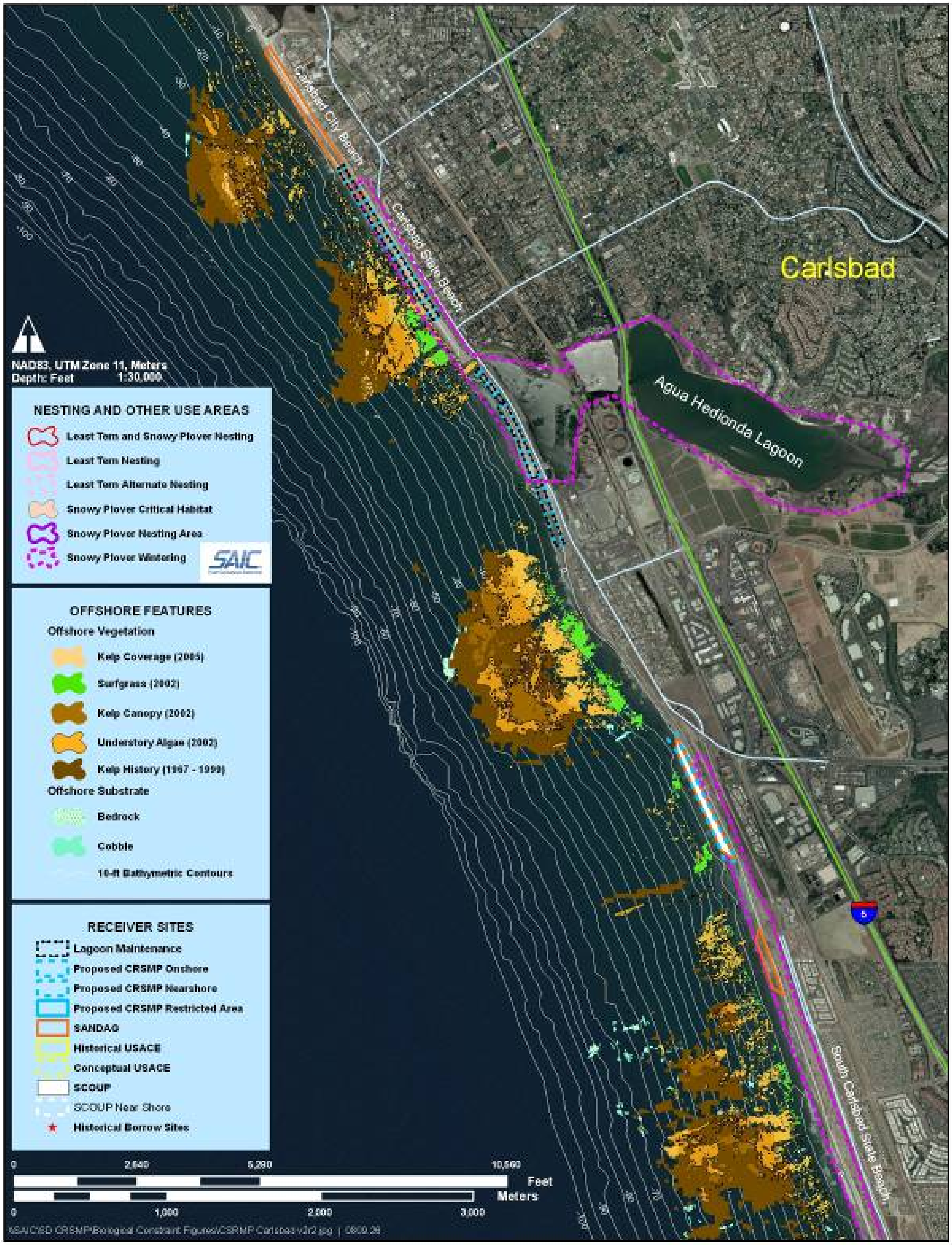


Figure 15 - Sensitive Biological Resource Areas in the Vicinity of Carlsbad Sediment Management Areas

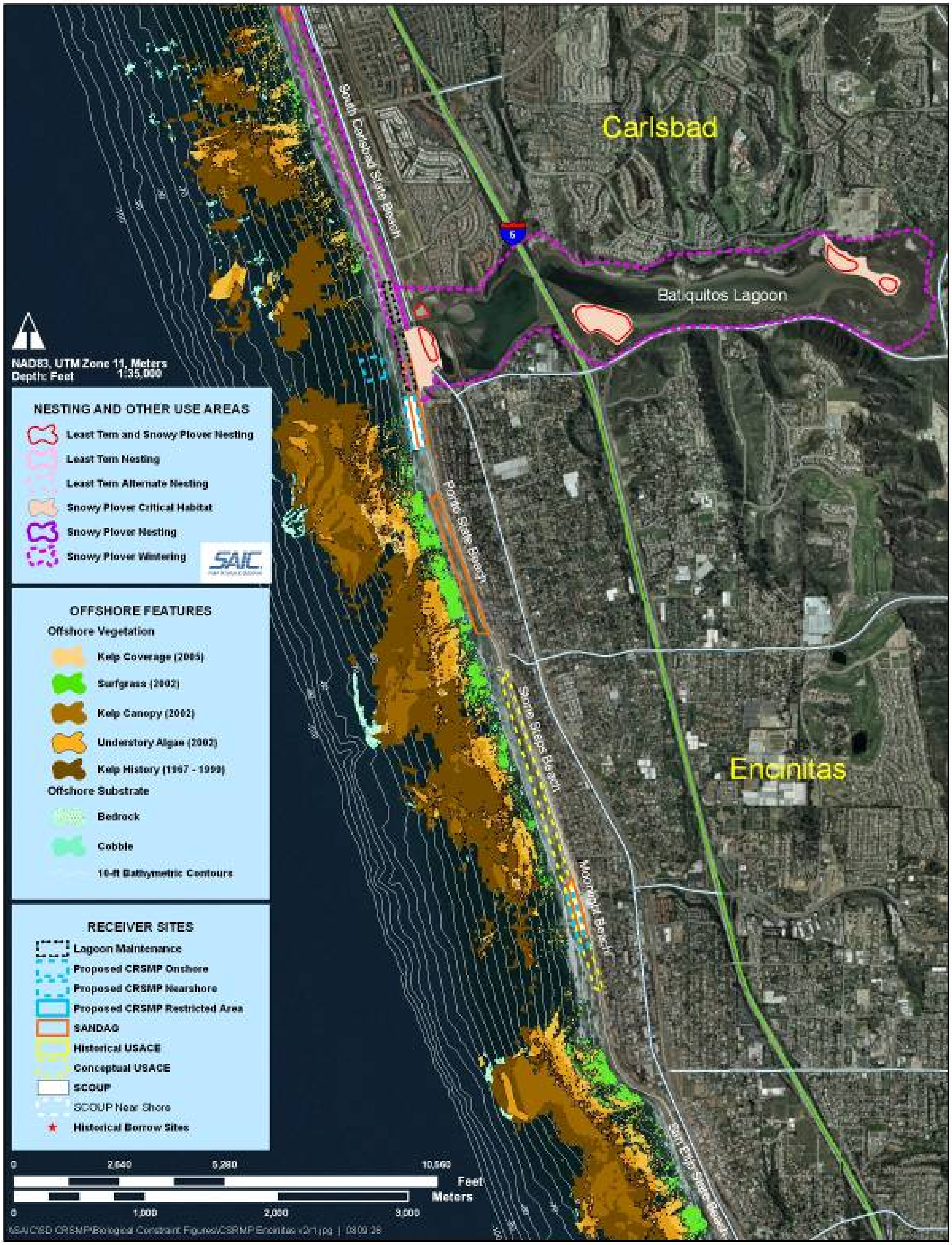


Figure 16 - Sensitive Biological Resource Areas in the Vicinity of Carlsbad and Encinitas Sediment Management Areas

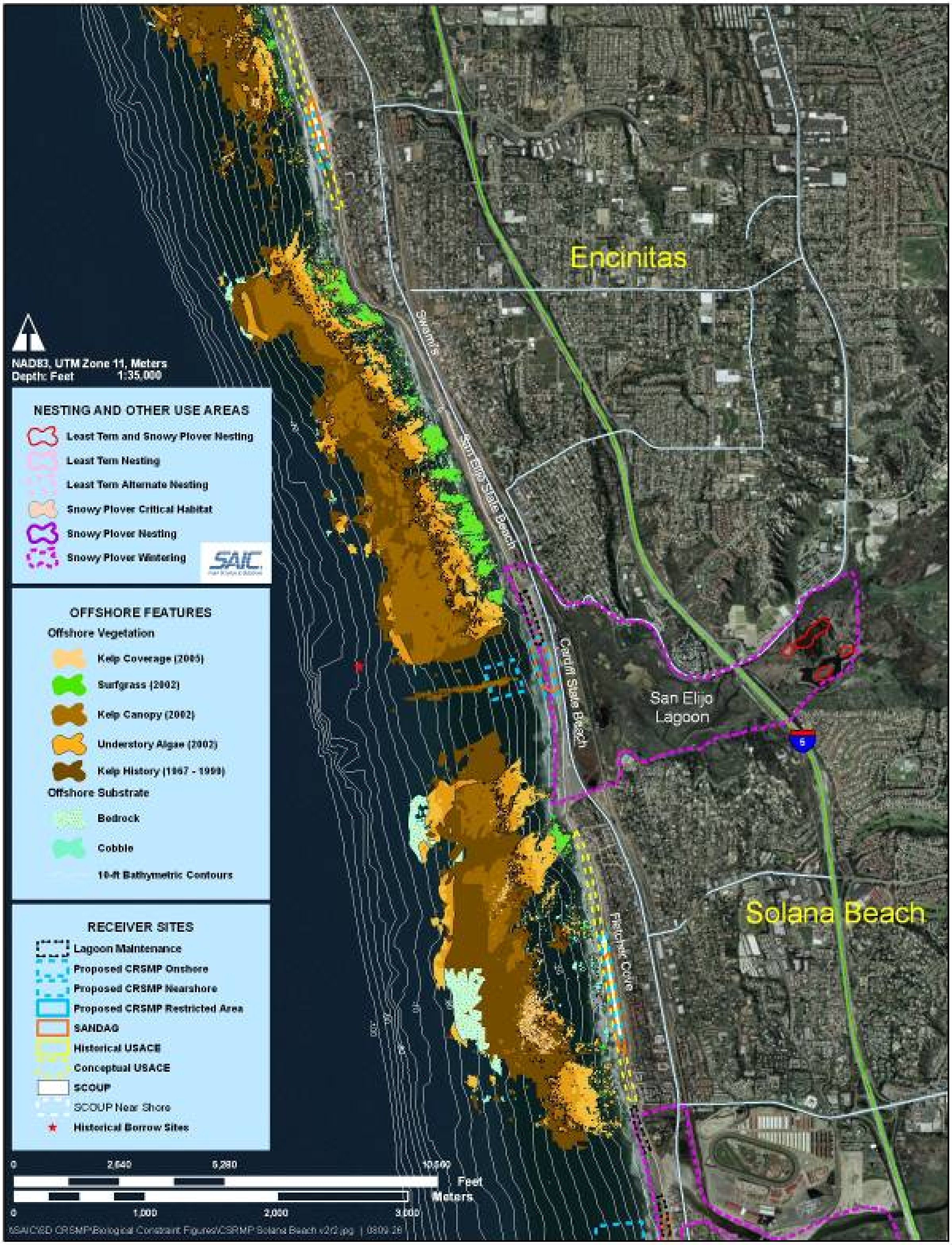


Figure 17 - Sensitive Biological Resource Areas in the Vicinity of Encinitas and Solana Beach Sediment Management Areas

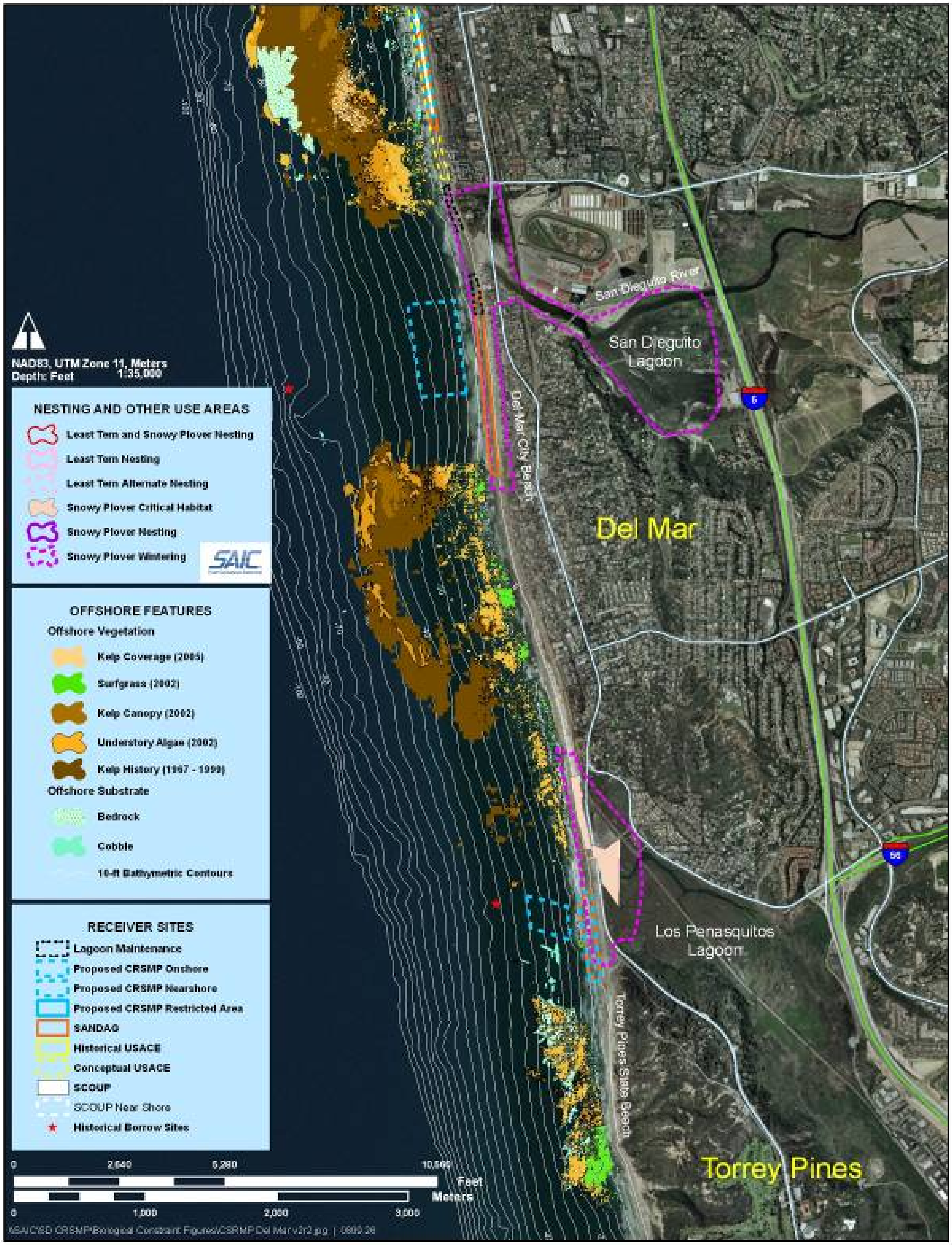


Figure 18 - Sensitive Biological Resource Areas in the Vicinity of Del Mar and Torrey Pines Sediment Management Areas

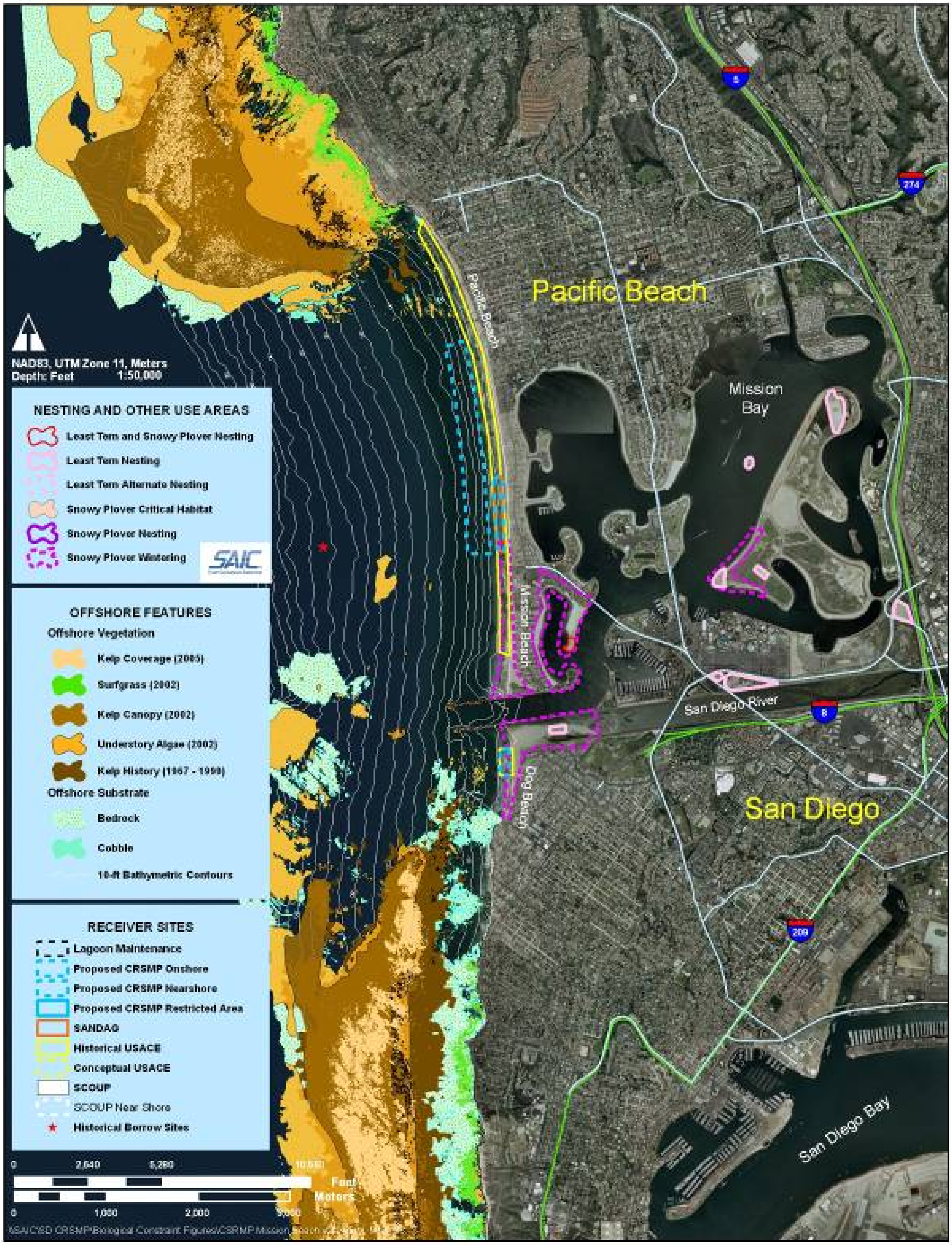


Figure 19 - Sensitive Biological Resource Areas in the Vicinity of Mission Beach Sediment Management Areas

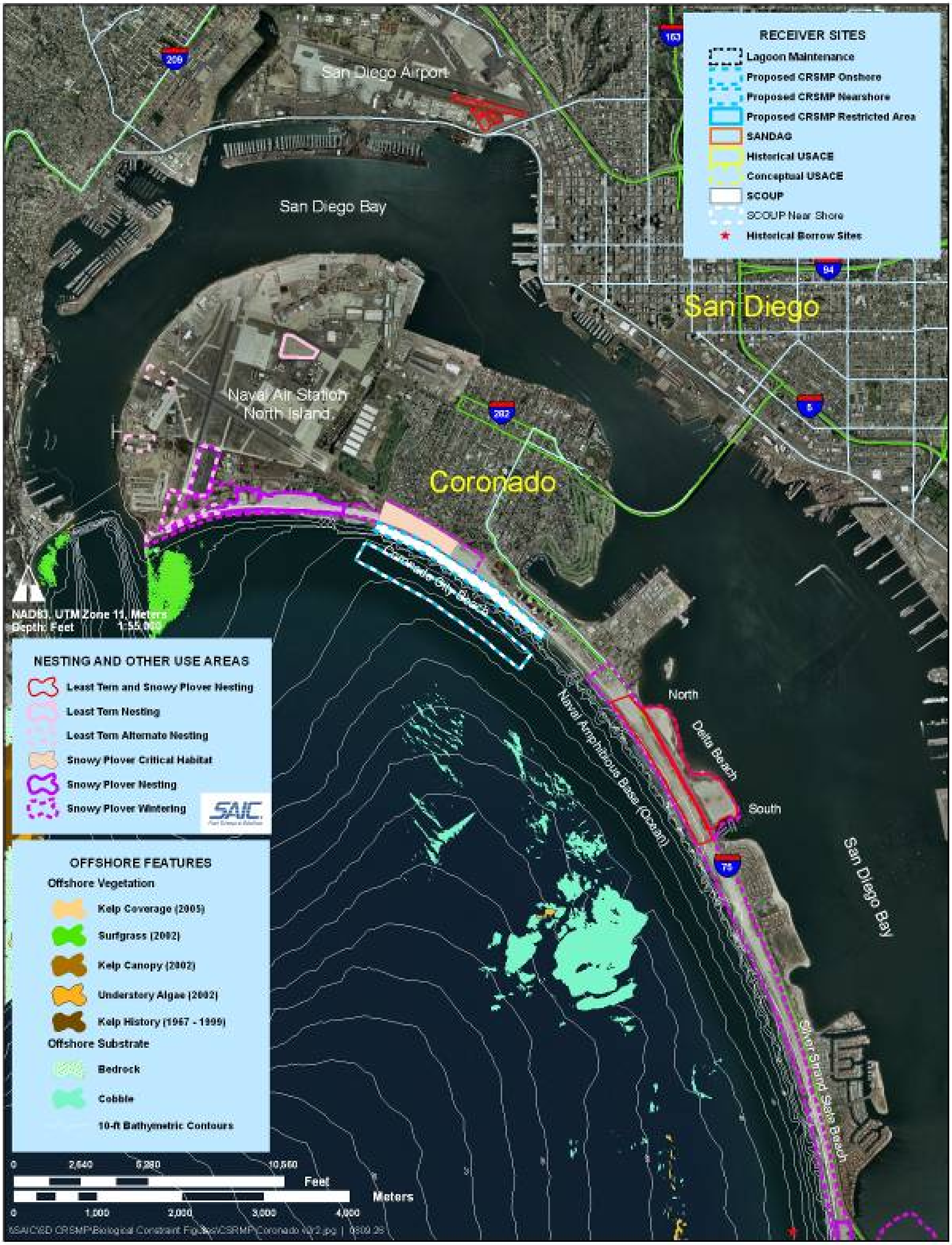


Figure 20 - Sensitive Biological Resource Areas in North San Diego Bay in the Vicinity of Coronado Sediment Management Areas

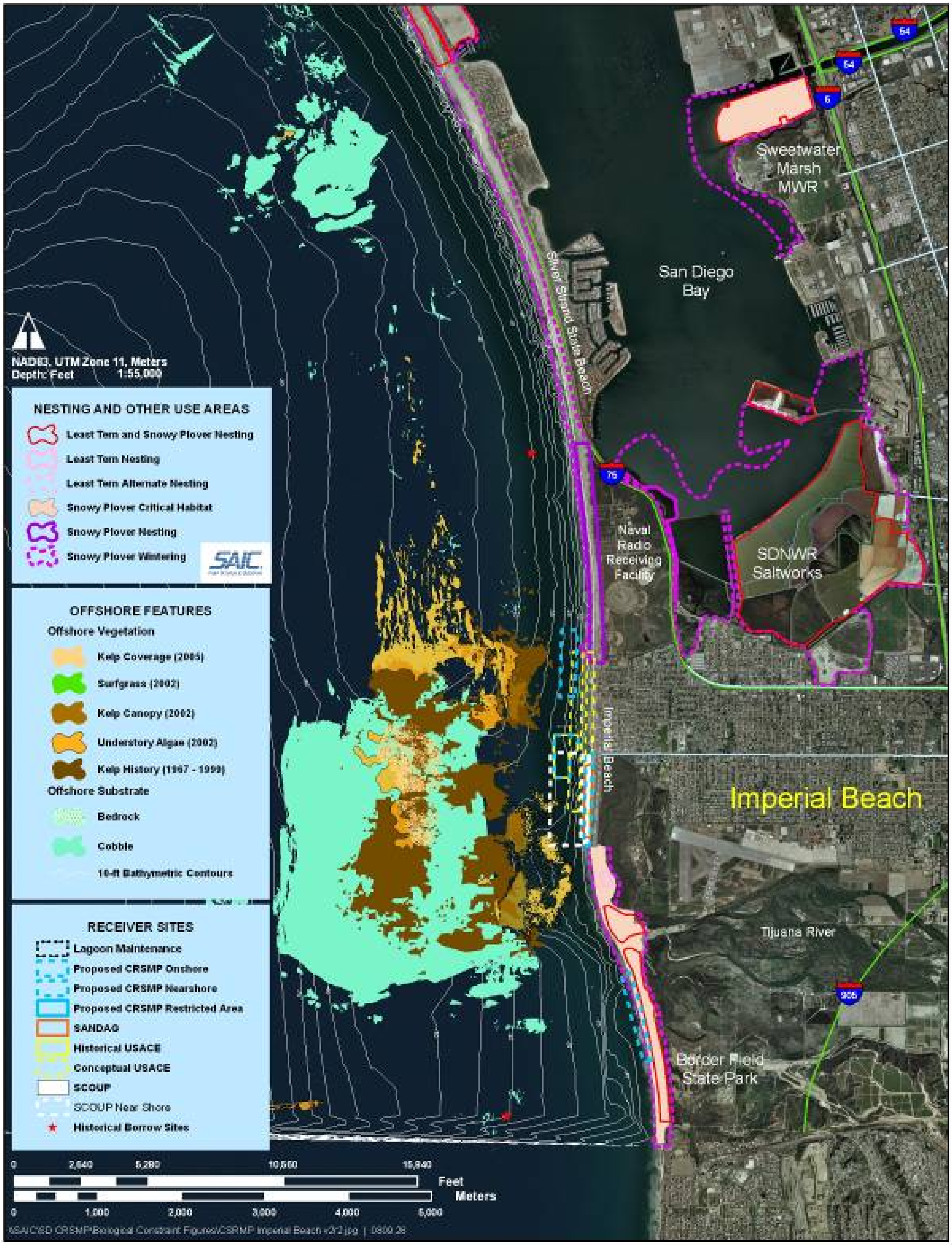


Figure 21 - Sensitive Biological Resource Areas in the Vicinity of Imperial Beach Sediment Management Areas

Habitats	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
▪ 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 4 - Regional Distribution of Habitats in San Diego County

ID	Receiver Sites	Nearshore Reef	Surfgrass	Offshore Kelp Bed	Other Rocks (R), Pier(P), and/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]	264 0	264 0	264 0	[3]	0[2]	2640	0	3000	1500	1500	0
1.	South Oceanside on-beach							√				
2.	South Oceanside nearshore*				R/P							
3.	North Carlsbad on-beach	√	√	√			√	√				√
4.	Agua Hedionda on-beach	√	√	√			√	√				√
5.	South Carlsbad on-beach	√	√		R			√				√
6.	Batiquitos Beach on-beach	√	√	√		√	√	√	√	√	√	√
7.	Batiquitos nearshore *	√	√	√	O^{+}		√		√			
8.	Leucadia on-beach	√	√	√				√	√			
9.	Moonlight Beach on-beach	√	√	√	R			√				
10.	Cardiff Beach on-beach	√	√	√			√	√	√			√
11.	Cardiff nearshore*	√	√	√	O		√		√			
12.	Fletcher Cove on-beach	√	√	√				√				
13.	San Dieguito nearshore*				O^{+}		√					
14.	San Dieguito on-beach*	√		√			√	√				√
15.	Del Mar on-beach	√	√	√			√	√				√
16.	Torrey Pines on-beach	√	√			√	√	√				√
17.	Torrey Pines nearshore*	√			O		√					
18.	Mission Beach on-beach							√	√			√
19.	Mission Beach nearshore*				O^{+}				√			
20.	Ocean Beach on-beach*	√			P			√	√			√
21.	Coronado Beach on-beach					√		√	√	√	√	√
22.	Coronado Beach nearshore								√			
23.	Imperial Beach on-beach	√		√		√		√	√	√		
24.	Imperial Beach nearshore (N)	√		√	P				√			
25.	Imperial Beach nearshore (S)	√		√	P				√			
26.	Tijuana Estuary on-beach					√		√	√	√	√	√

Sources: Figures 14-21; + = MEC 2000
* = 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 based on site- and/or project-specific conditions

Table 5 - Sensitive Biological Resources Near Sediment Management Receiver Sites

4.4.3
Impact Considerations

Several types of impact concerns have been identified in reviews of dredging and/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 sediment management and relate to the potential to damage sensitive habitats and/or interfere with critical life functions of sensitive species from equipment, sediment removal, and/or sediment placement. Potential impact considerations during the construction phase include:

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

After sand placement, impact concerns relate to recovery rates of soft-bottom habitat functions and the potential for sand movement by waves and currents to become trapped and/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 and/or loss of surfgrass beds;
- Sedimentation and loss of offshore kelp beds;
- Sedimentation that results in substantial shoaling and/or closure of lagoon inlets; and
- Sedimentation that increases the frequency and/or volume of maintenance dredging in lagoons and/or harbors.

Potential impacts may have adverse, beneficial, and/or no effect on habitats and/or species depending on timing of activities, magnitude of effect, and/or vulnerability or tolerance to disturbance. Consequently, locations of sensitive habitats and resources may constrain volume, schedule, and/or frequency of sediment management activities. The following subsections summarize primary impact considerations associated with selected sensitive habitats and resources of particular concern for coastal sediment management activities in San Diego County.

Sandy Beach and Subtidal Habitats

The intertidal portion of sandy beaches may be 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 with less disturbance 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 and/or nursery habitats (Cross and Allen 1993). For example, California halibut migrates inshore in late winter and early spring to spawn and remain in shallows 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 and/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 and/or by interfering with prey capture (Greene 2002; Peterson, et al. 2002).

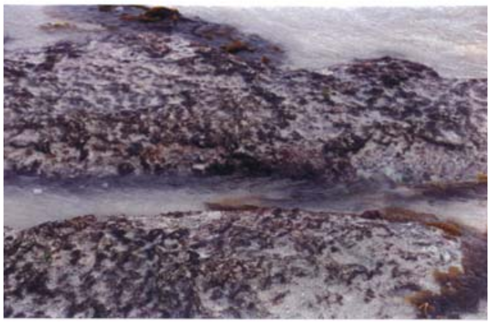
Sandy beach habitat may be enhanced by beach nourishment in erosive beach areas (Melvin, et al. 2001, CZR 2003, SAIC 2006). Sand is the limiting factor associated with seasonal development of the invertebrate community and functional use of the beach for spawning by grunion and foraging, resting, and/or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

Sediment management impact considerations for sandy beach and/or subtidal habitats include:

- Compatibility between source sands and native sands;
- Timing of on-beach activities relative to invertebrate recruitment periods;
- Proximity to critical habitat, nesting areas, and/or winter concentrations of snowy plovers;
- Frequency of disturbance;
- Potential for modification to hydrodynamics and/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/Rocks

Rocky habitats are localized in occurrence 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 biological resources. Similarly, cobbles subject to sand scour and tumbling from wave action support few biological resources.



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

Nearshore reef off Encinitas
Photograph by Danny Heilprin, 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 and/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).

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

- Potential for substantial turbidity and/or sedimentation based on sand volume and proximity of sediment management activities;
- Reef heights and habitat quality; and
- Existing uses (e.g., commercial and/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.

Photograph by: Karen Green, SAIC

Surfgrass beds are ecologically sensitive, supporting a variety of habitat functions including forage, 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 and/or substantial burial of leaves reduces photosynthesis and growth and may lead to habitat degradation and/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 and/or loss of the rhizome mat. Artificial reestablishment of surfgrass beds using seeding and/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 sediment management projects when surfgrass habitat occurs nearby.

Sediment management impact considerations for surfgrass include:

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

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, educational, and recreational values. 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.

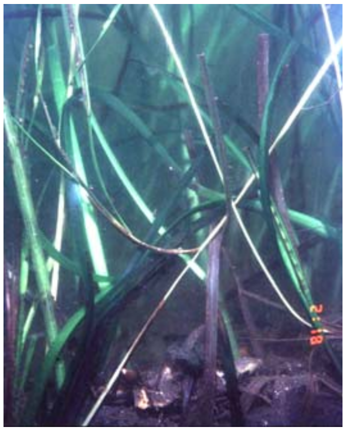
Kelp plants are vulnerable to vessel impacts (propellers, anchoring) resulting in frond entanglement and/or dislodgement of holdfasts. Kelp forest and associated understory vegetation also are sensitive to changing light levels and are limited when light transmission is substantially impaired. Light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

Kelp forests are highly vulnerable to sedimentation impacts, which can potentially damage plants from abrasion and scour and/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 and/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 active growth periods, 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 physical impacts that results in disruption of sediment, removal of rhizomes, and removal of seed bank. 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 rhizomes or the seed bank. Eelgrass habitat loss requires replacement consistent with the Southern California Eelgrass Mitigation Policy.

Sediment management impact considerations for eelgrass include:

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

Coastal Dune and/or Strand

Native coastal strand vegetation is designated as rare in California. Coastal dune and/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 and/or limited sand supply and erosive conditions often lack coastal strand vegetation on the backshore and/or lack adjacent coastal dunes. Consequently, functional coastal strand backshore and/or dune habitat only occurs in

Limited coastal strand near Batiquitos
Photograph by Karen Green, SAIC

localized areas.

Coastal dune and/or strand vegetation are adapted to 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 and/or rhizomatous roots, and dense growth patterns that help anchor and protect individual plants from shifting sands and winds (CNPS 1996). However, coastal dune and/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).

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

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

California Grunion

Grunion is a pelagic, schooling fish that generally occurs from just beyond the surf line to a depth of approximately 60 feet off sandy beaches. 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).

Photograph by Doug Martin

California grunion spawns on beaches in southern California between late February and early March and 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 through August, but the fishing season is closed in April and May.

During spawning, grunion swim as far up the beach as possible on the breaking wave. 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 tide series to 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 associated 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 the 2001 RBSP (SAIC 2006). Thus, beach nourishment may benefit California grunion by creating or expanding sandy beach spawning habitat.

Primary concerns regarding impacts to grunion are that beach nourishment will disturb, bury, and/or otherwise adversely affect spawning success. Turbidity also has the potential to affect adult fish during sediment management activities.

Substrate compatibility is an important consideration for habitat suitability. Fine sediments can block interstitial spaces in 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 and/or limit egg survival. Narrow beach width and/or slopes that are too flat could result in egg wash out or saturation.

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;
- Potential for sand placement and equipment operation in spawning habitat;
- Occurrence of grunion during project implementation; and
- Potential to enhance suitability of spawning habitat.

Snowy Plover

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. The breeding season for western snowy plovers extends from early March to late September.

Photograph by Callie Bowdish

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. In beach areas, 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 and increases their vulnerability to being run over by vehicles or being trampled in areas of human disturbance (Lafferty 2000). Birds are relatively tolerant at distances greater than 100 feet (Lafferty 2000, 2001).

Sediment 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, and/or in areas of wintering concentrations. Sediment 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 and/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).

Photograph by Kathy Keane

Least terns feed on small surface schooling fishes such as topsmelt, northern anchovy, jacksmelt and mosquitofish. They are terns opportunistic in their foraging behavior and may shift locations in response to localized concentrations of suitable prey (Atwood and Minsky 1983). Least terns 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 are dependent on an adequate supply of small fishes near their breeding colonies. When the adults are foraging away from their nests, young are left unprotected and vulnerable to predation.

Sediment management projects may require consultation with the USFWS and USACE under Section 7 of the ESA 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. Sediment 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 considerations and existing and potential future sediment sources that could be used as fill within the San Diego County area is presented within this section. Certain information regarding sources is defined, while other information regarding the material properties, the timeframe of their availability and costs for their transport vary and are still being determined. Characteristics of sediment source types are provided in **Table 6.** These sources vary in quantity and the frequency of which they become available as shown in relative qualitative terms in **Table 7.** The list in Table 7 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)	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

5.1 Locations – Upland, Coastal, and Offshore

Sources range from those located within the local watershed, to those within the region and possibly farther away from the site, and those on land and in water. Each source location is briefly described below.

5.1.1 Upland Sources

Sediment sources exist west of the coastal watershed drainage divide. Sources are more generally numerous downstream closer to the coast and less numerous farther inland due to topography and greater intensity of development. The SCOUP document (2006) inventories upland sediment sources that include development sites, rivers, flood control channels, sediment detention basins, and roadway widening projects and this document updates that inventory. Source locations are diverse, but are generally most numerous within drainage courses as water-related infrastructure (flood control). Maps of sediment source locations are included as **Figures 22 to 24.**

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	Unknown	<1	City of Carlsbad	Bi-annually	Steve Jantz (Carlsbad)	(760) 602-2738
NC-CB-EC	Carlsbad	Encinitas 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)	
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)	
NC-SEL	Cardiff	San Elijo Lagoon Restoration	800,000	1-3	County of San Diego	Unknown	Frank Wu (USACE)	(213) 452-3684
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	
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

(cont.)

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			3-5 years	Kevin Quinn (City San Diego)	
NI-LHR	County of San Diego	Lake Hodges	2,132,000	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)	
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	Unknown	>10	Unknown	Unknown	Unknown	
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	2,112,000	>10	County Water Authority	Unknown	Sid Tsoro (San Diego (County)	
CI-SVR	Blossom Valley	San Vicente Dam Maintenance	456,000	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	
CI-SLR	Ramona/Julian	Sutherland Dam Maintenance	92,000	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	
CI-LLR	County of San Diego	Loveland Lake Reservoir	Unknown	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	
CI-LPV	County of San Diego	Lake Palo Verde	Unknown	>10	County Water Authority	Unknown	Rosalva Morales (SDWD)	
South County								
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 Coronado	Sea Coast Inn	30,000	<1	Private Developer	2008-2009	Unknown	Unknown

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								
SO-9	Offshore	SO-9	873,000 Unsuitable, very fine sand	1.1	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-7	Offshore	SO-7	No Sand Remaining after SDRBSP	0.6	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-6	Offshore	SO-6	688,000 Remaining after SDRBSP	0.8	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-5	Offshore	SO-5	5,480,000 Remaining after SDRBSP	0.9	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SO-4	Offshore	SO-4	1,500,000 Fine grain	0.6	State of California	Now	Ken Foster (SLC)	(916) 574-2555
MB-1	Offshore	MB-1	25,737,000 Remaining after SDRBSP	0.9	State of California	Now	Ken Foster (SLC)	(916) 574-2555
SS-1	Offshore	SS-1	7,592,000 Unsuitable, very fine w cobbles	1.4	State of California	Now	Ken Foster (SLC)	(916) 574-2555
Santa Margarita River	Offshore	SM-1	Unknown (TBD)	0.5	State of California	Now	Ken Foster (SLC)	(916) 574-2555
Zuniga Shoal	Offshore	ZS-1	Unknown (TBD)	2.1	State of California	Now	Ken Foster (SLC)	(916) 574-2555
Torrey Pines	Offshore	TP-1	Unknown (TBD)	0.7	State of California	Now	Ken Foster (SLC)	(916) 574-2555

Table 7: Typical Quantities and Timing of Existing Sediment Sources

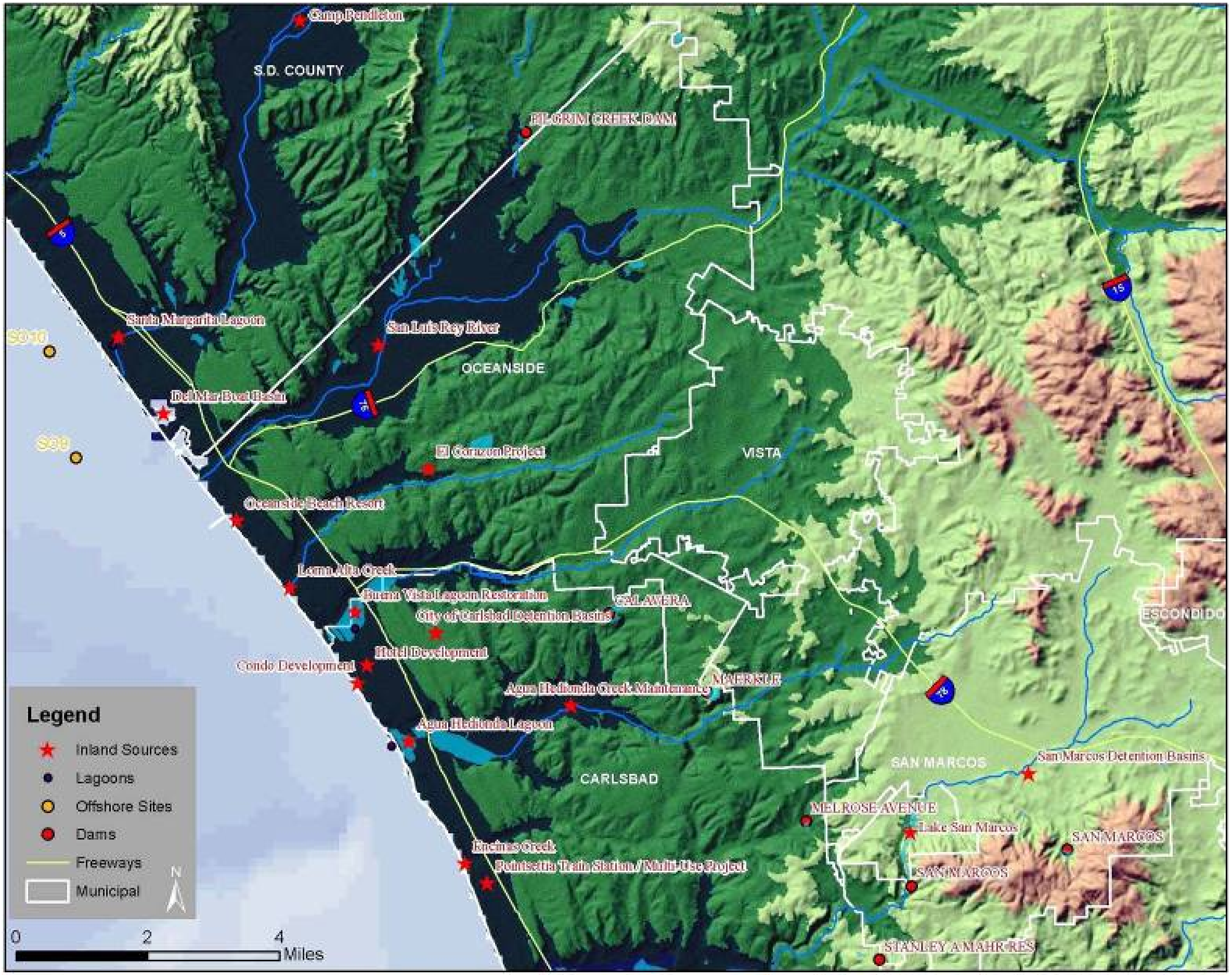


Figure 22 – Sediment Source Locations in the North County Region

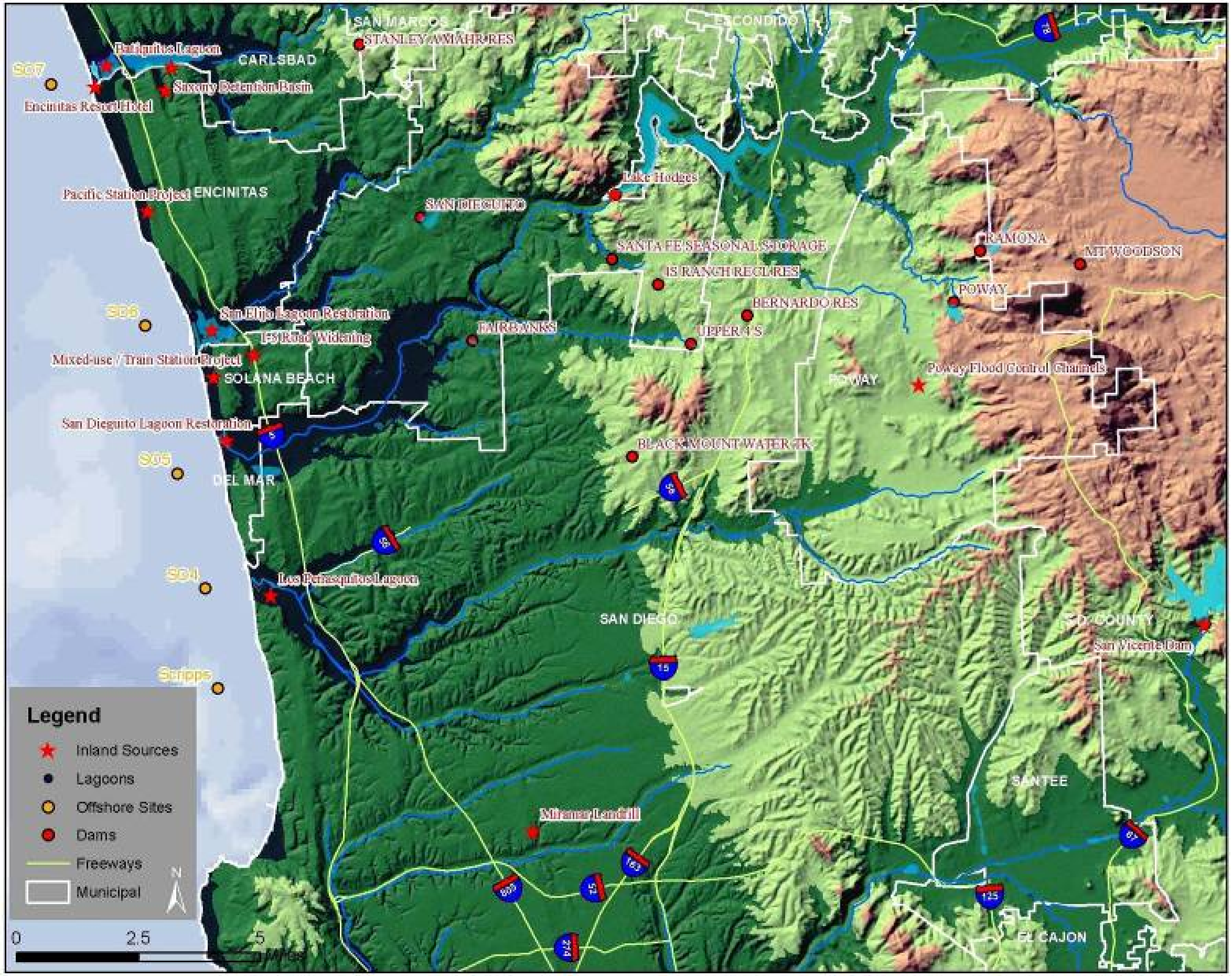


Figure 23 – Sediment Source Locations in the Central County Region

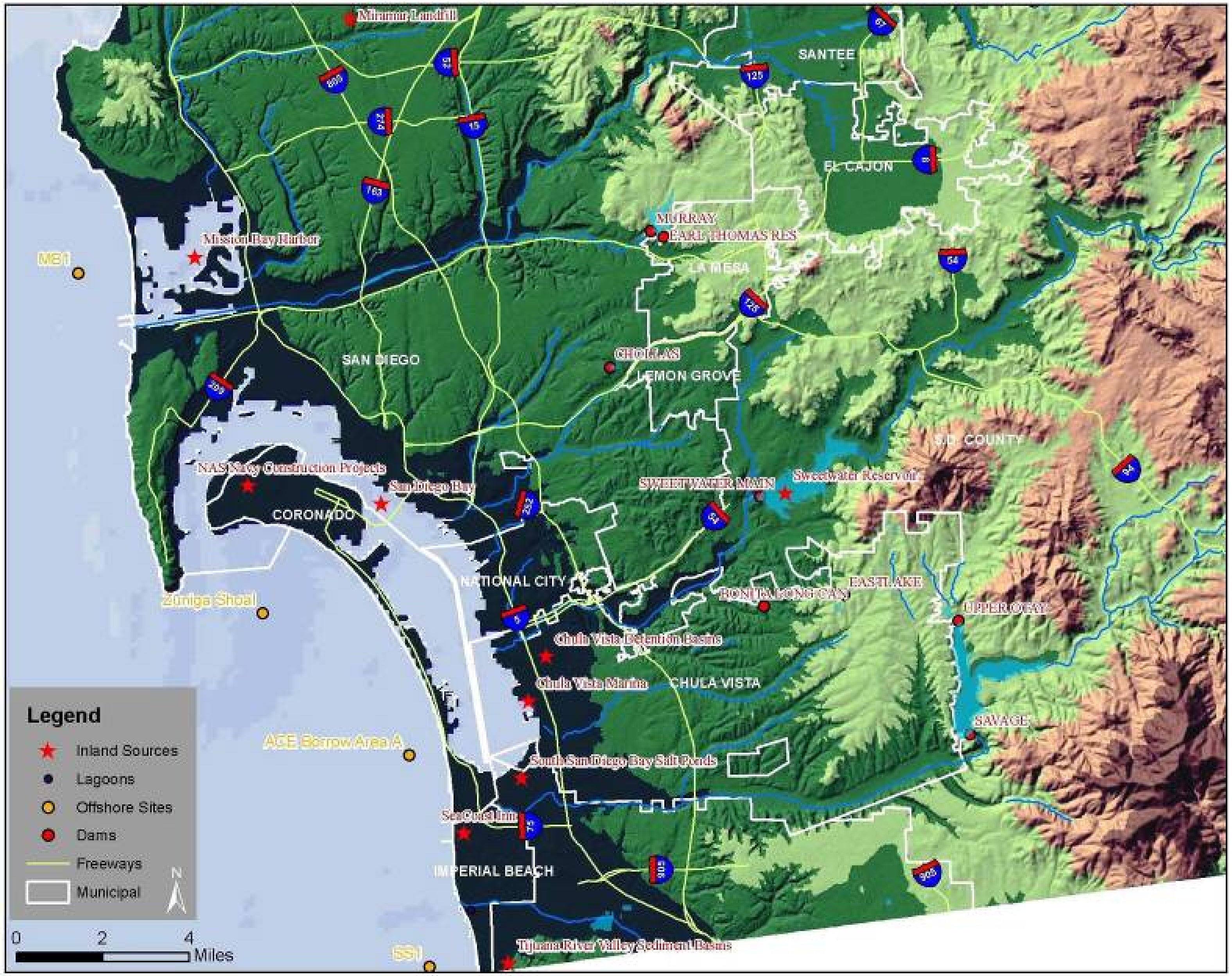


Figure 24 – Sediment Source Locations in the South County Region

5.1.2
Coastal - Lagoons and Harbors

Six lagoons, one estuary, and three harbors exist within the Coastal RSM Plan region as shown in **Figure 25.** 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.

All of these lagoons have been dredged or are possibly proposed for dredging at some point in the future.

The three harbors within the Coastal RSM Plan area include Oceanside Harbor, Mission Bay, and San Diego Bay. Oceanside Harbor is dredged annually and sand from the harbor is placed downcoast along the beaches of Oceanside south of the pier. The City of San Diego plans on dredging Mission Bay in the near future for maintenance, and San Diego Bay is periodically dredged due to sedimentation that occurs within the harbor. Dredging is currently being planned within San Diego Bay Harbor 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 any contaminated sediments are disposed of in an appropriate manner without being used for beach nourishment. Beach nourishment materials are required by law to be clean.

5.1.3
Offshore Sources

Offshore sediment sources exist along the entire reach of the Coastal RSM Plan region as have been previously identified by SANDAG and used for RBSP I. Offshore sand source locations are shown in **Figure 26.** Ten offshore borrow sites were previously investigated as part of this project. 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-1 off Imperial Beach north end (also referred to as USACE Area A); and

- SS-2 off the Tijuana River Estuary.

Through this investigation it was determined that SO-4, SO-8, AH-1, and SS-1 (USACE Area A) did not meet grain size criteria. Sites SO-9, SO-7, SO-5, MB-1, and SS-2 were initially used by SANDAG for RBSP I. During construction, SO-9 and SS-2 were eliminated from consideration due to the fine grain sizes and cobble, respectively, being dredged. 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 the upcoming SANDAG Regional Beach Sand Project in 2011 or 2012 (RBSP II), representing essentially a duplicate to RBSP I, some of the same sites and three new sites are being 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).

Exploration of TP-1 as part of RBSP II was a result of data presented from recent offshore investigations by SIO. The results of this study were published in an article titled "Long-term tectonic control on Holocene shelf sedimentation offshore La Jolla, California" (Hogarth, Babcock, Driscoll et al. 2007) in the *Geological Society of America*. This type of study, performed by Dr. Neal Driscoll and his team, is referred to as offshore neotectonics, which studies the affects 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 offshore, uplifted bedrock portions of the Rose Canyon Fault Zone. Areas of trapped sand included a site immediately north of the Scripps Canyon and a site between the Scripps Canyon and the La Jolla Canyon. The study found these sand deposits to be nearly 20 meters (66 feet) thick in these areas, 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. Therefore the TP-1 site is located immediately upcoast of the Scripps Submarine Canyon deposit where sand has accumulated along a six kilometer stretch of a shore-parallel, uplifted bedrock that has resulted in a relatively thick lens and of sand referred to as a "sand belt."

SANDAG performed offshore investigation of sand 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. Results indicate the following regarding quality for nourishment:

- 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.

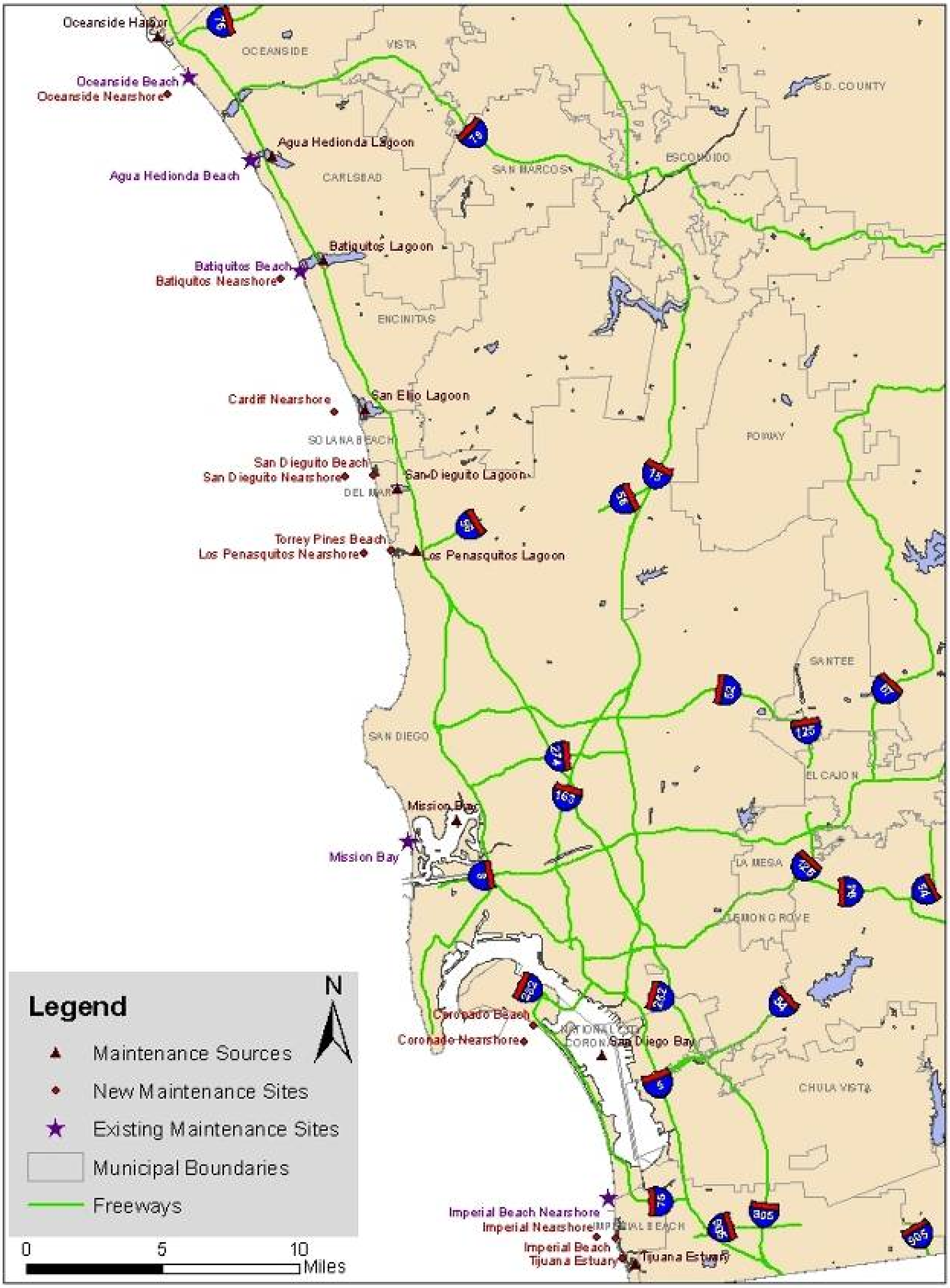


Figure 25 – Lagoons and Harbors in San Diego County

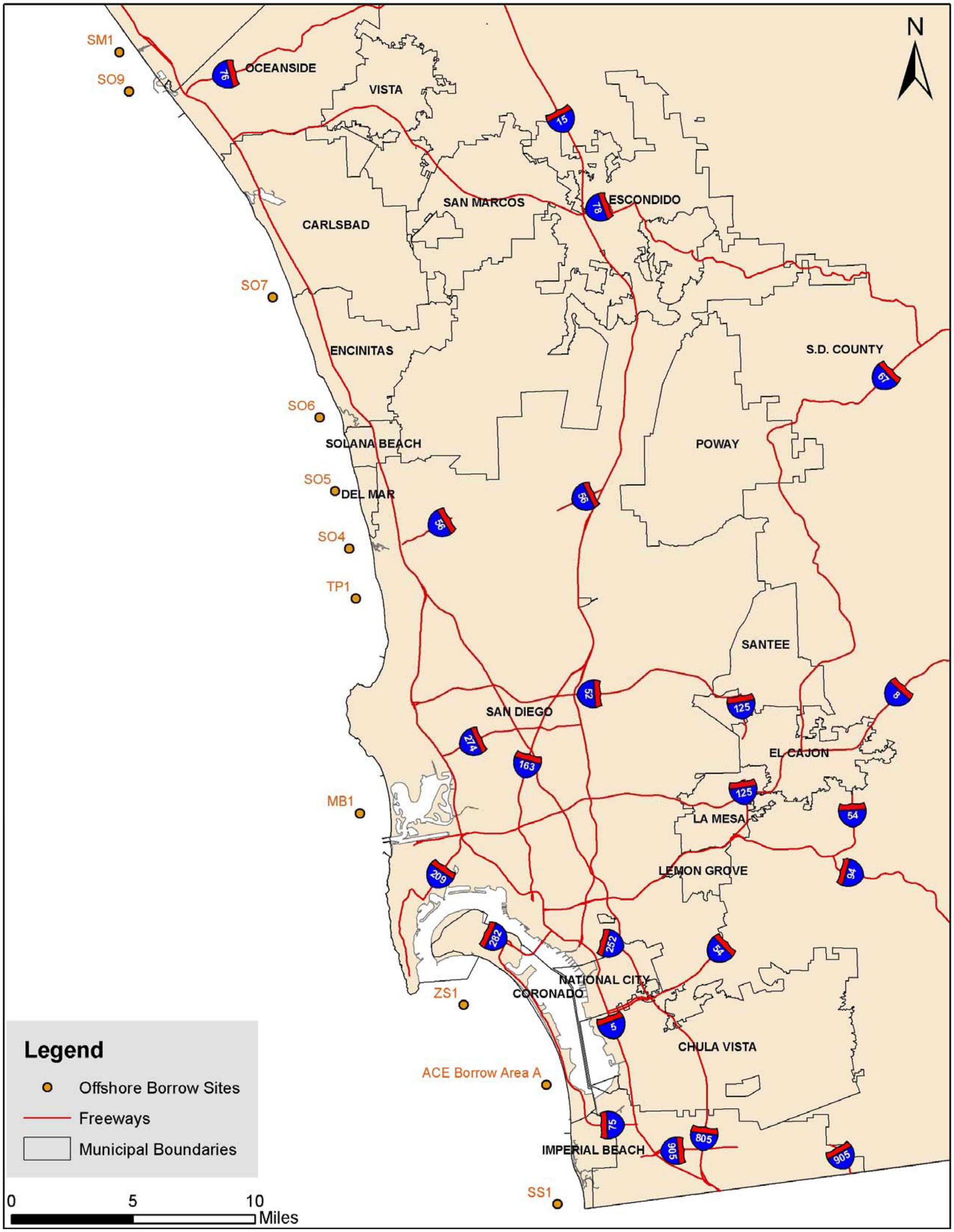


Figure 26 – Offshore Sand Sources in San Diego County

5.2 Quantities

Anticipated approximate sediment quantities for upland, lagoon and harbor and offshore sources are discussed in this section. These quantities are also listed by source in **Table 7.**

5.2.1
Upland Range of Quantities

Source sediment quantities vary broadly, and generally are less than 50,000 cubic yards. 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 very small, generally less than 25,000 cubic yards.

Exceptions are reservoirs behind dams that can yield millions of cubic yards. Road widening projects, such as I-5 widening by Caltrans, can also generate larger quantities of material. The I-5 was widened from Sorrento Valley in San Diego through Del Mar for a distance of several miles. Caltrans plans on widening the 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 Range of Quantities

Lagoon sediment quantities are generally small to moderate and range from 25,000 to 500,000 cubic yards, while harbor sediment quantities are generally moderate to large and range from 100,000 cubic yards to millions of cubic yards.

5.2.3
Offshore Range of 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 source location proximity to receiving beaches. Operating water depths for hopper dredges are typically in the 20 to 70 foot depth range. However, modifications can extend dredge depths down to 90 feet. Dredging operations are limited to areas outside the surf zone and dredging materials 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 their relatively large surface area on each particle and their tendency to attract opposite charges of chemicals. Sand grains possess smaller surface areas compared to silts and clays, and chemical molecules are less able to adhere to their surface. Therefore, relatively high proportions of silts and clays in sediment presents a greater probability for existing of contaminants compared to sediments with lower proportions of fine-grained particles.

5.3.1 Upland Sediment Quality

Sediment quality varies widely, with chemically clean sediment found deeper in the sandy geologic layers beneath surface layers. Upper layers of upland sediment can contain contaminants that leach into the soil from above. The likelihood of contaminants being present is greatly influenced by the historic and present land uses on the surface. Contaminants present in sediments tend to be in surface layers within the first five feet of deposits from surface application. Potential contaminants include pesticides, oils and grease, bacteria, PCBs, hydrocarbons, plastics, and other chemicals. The SCOUP document (2006) also discusses upland sediment quality.

5.3.2 Lagoon and Harbor Quality

Lagoon and harbor sediment sources typically have higher 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 during both dry and wet seasons can contain chemical contaminants, which can be retained within the lagoon’s finer-grained sediments. Sediment distribution within lagoons varies, dependant 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 watershed.

Sediment quality in harbors typically has medium percentages of fines due to harbors being subject to tidal flows. However, these 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-foaling paints that are applied to boat hulls.

5.3.3 Offshore Ocean Quality

The grain size distribution of offshore sources varies spatially, but is largely sand with some silt overburden. 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 Terrestrial Ownership

Ownership of terrestrial sources is typically a private entity or local government, with the local government or state agency having discretionary authority over the development of the site.

5.4.2 Lagoon and Harbor Ownership

Ownership of lagoons is generally by the State of California and local agencies. Harbor ownership varies and can be the local City, Port authority, USACE, Navy, or local jurisdiction.

5.4.3 Offshore Ocean Ownership

Offshore source ownership is the state of California and administered by the California State Lands Commission, and included within the jurisdiction of the California Coastal Commission. 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

Terrestrial sand tends to be available on an on-going basis as development occurs throughout the region. The availability of specific sources depends on the project status and can be from immediate to five years or more.

Lagoon and harbor sand is typically available each year as 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 significant projects. The latest two significant lagoon restoration projects were Batiquitos Lagoon in 1995 and San Dieguito Lagoon in 2007 (twelve years apart).

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).

5.6 Contact Person and Information

Available contact information for sand sources is shown in Table 7 referenced previously in this section. The table provides the contact person and their 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.

5.7 GIS Data Layers

Geographic Information System (GIS) data layers of sand sources from terrestrial 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.

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 category 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. A possible management approach for each sediment source is 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:

On-Shore – Sand placed on the dry beach as a berm, between the elevation of 0 feet relative to and +12 feet relative to MLLW is considered on-shore placement. Sand placed on-shore as a beach berm is typically optimal sand. Also, sand placed in the high-tide surfzone by earthmoving equipment from the dry beach is also considered on-beach. The high-tide surfzone is accessible at lower tides, but becomes inundated at higher tides. Surfzone 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 greater than -5 feet MLLW and out to -30 feet MLLW is considered nearshore placement. Nearshore placement is suitable for any type of sediment. It is intended to provide for flexibility in nourishment activities if placement volumes are greater than can be accommodated on-shore due to environmental constraints, and/or if the sediment quality is less-than-optimal.

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 ranging from optimal 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, meaning they contain a broad range of grain sizes mixed together. In contrast, materials from dry 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 activity, and the number of site-specific sources tend to be greater than wet upland sources (i.e., there are more sources distributed over a map than lakes, rivers, and streambeds). Dry upland sources are typically smaller in quantity than these wet upland sources, but can range more broadly in area 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 caused by use of upland fill. Similar environmental windows are likely to be required for different types of fill, with the exception of ocean sediment (containing fewer fines) that can be placed during summer if monitoring occurs to verify turbidity levels and lack of impacts.

6.1.2
Transportation

Terrestrial material is typically transported by truck to the discharge site. Other modes of transport are possible, including train, conveyor belt and/or hydraulic pipeline (from lakes) through suitable terrain. However, innovative measures such as sluicing material from reservoirs through river valleys are not considered as commonly feasible due to the logistical and practical difficulties, such as permitting restrictions of working in sensitive riparian habitat areas. 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. Certain receiver sites may be able to be retrofitted with infrastructure to receive material by rail. These are not yet called out on figures in this report because further study is needed to identify suitable sites in light of the future double-tracking plans by the North County Transit District. For this version of the Coastal RSM Plan, most or all opportunistic sand sources are assumed to be delivered by truck.

6.1.3
Receiver Sites

Beach receiver sites for upland material are all surf-zone placement sites. Surf-zone placement sites are considered “on-beach” relative to the deeper nearshore zone (at depths of -5 feet relative to MLLW and deeper) if they are accessible by earthmoving equipment. These receiver sites are generally located in proximity to transportation routes for ready access. Sites are designated as potential receivers of opportunistic beach fill material if they are accessible from a major access route, and are located relatively far from residential land uses (compared to other Coastal RSM Plan sites) to minimize disturbance, and potential issues with public safety and circulation.

- **Logistics**

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

  Receiver sites for opportunistic sand should be positioned near the location of regional east-west access routes to benefit from material generated inland. Therefore, 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 distant from residential land uses, possessing construction access ramps, and others considered in that document. If possible, receiver sites for opportunistic sand should also be in the vicinity of stockpile areas 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**

  Potential opportunistic beach fill project logistics for North San Diego County are briefly described herein, and are derived from and expanded upon from existing and proposed opportunistic beach fill programs at Oceanside, Carlsbad, Encinitas, and Solana Beach. A discussion of North County opportunistic sand operations (regional transport routes and receiver sites) is provided below.

  Regional transport routes relative to beach locations are shown in **Figure 27** and also listed below.

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

  Receiver sites relative to transport routes are listed below:

  - 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);
  - Encinas Creek Beach 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 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);

- Cardiff 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 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 28 and 29**. 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 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 opportunistic beach fill project logistics for South Central and South San Diego County are mainly derived from and expanded upon from 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.

Receiver sites relative to transport routes are listed below:

- 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 Dog Beach);
- Coronado 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 30 and 31.** 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 – Regional Transport Routes in San Diego County

Figure 28 – North County Upland Sand Receiver Sites

Figure 29 – Central County Upland Sand Receiver Sites

Figure 30 – South Central County Upland Sand Receiver Sites

Figure 31 – South County Upland Sand Receiver Sites

6.1.4
Habitat Considerations

Discharge of optimal sands generally is not constrained from the perspective of sediment compatibility. However, frequency and/or timing of placement are important considerations for minimizing potential adverse effects to biological resources such as:

- Sandy beach invertebrates;
- California grunion;
- California least tern; and
- Western snowy plover.

Construction activities have the potential to adversely impact the invertebrate community from burial and/or spreading of fill material with earth moving equipment. Invertebrates seasonally recruit to beaches and have a peak productivity period in spring-summer and lower abundance during fall-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. When opportunistic placements are conducted more than once a year, avoidance of repetitive placement of sand in the same location is recommended to minimize the footprint of disturbance and 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, sand placement during September 1 through February 28 minimizes potential effects to biological resources 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 recommended 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 scheduled between March 1 and September 30, pre-construction survey assessment and/or coordination with resource and regulatory agencies may 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 optimal sands with a relatively higher percentage of fines should be in less-sensitive areas due to turbidity and sedimentation concerns. Discharges near the mouths of active streams during the winter season would most closely approximate natural conditions. Discharges near sensitive reef and vegetated habitats and/or near nesting sites of California least tern during the breeding season are not recommended. Frequency, volume, and discharge rate should be controlled to minimize the potential for adverse and/or cumulative impacts to beach and nearshore 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 sediment characteristics in the vicinity of the receiver site are not significantly altered by placement of less than optimum sands. 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 of material is being trucked to the beach from a nearby debris basin, and the U.S. Geological Survey is monitoring the turbidity and pattern of sedimentation. The objective is to provide information for possible reconsideration of the 80/20 rule-of-thumb presently employed by the USEPA for project approvals. Results should be available in winter of the first quarter of 2009.

6.1.5
Placement Designs and Restrictions

Opportunistic 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 (EDAW 2006 and 2008; Moffatt & Nichol 2000c). Carlsbad possesses a separate program. 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 on-beach placement (the high, dry beach) as a berm if the material is optimal sand, or at the surf-line in a low-tide dike/mound if the material is less-than-optimum sand. Nearshore placement is less desirable because it requires hydraulic pumping to deliver it, and that 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 effects. 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). Materials with relatively high fines content (less-than-optimum sands) are placed at the beach at a specified rate over time to manage turbidity and potential impacts to invertebrates.

6.1.6 Stockpiling

Regional or subregional stockpile sites should be considered to increase the flexibility of opportunistic beach operations. Flexibility is needed to provide temporary staging of materials if the following possible conditions occur:

- Suppliers cannot fund transport to the coast;
- The materials need to be processed prior to delivery to the coast and cannot be processed at the source location; and
- 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 location is relatively close to receiver sites and/or the quantities of material to be transported are large. Source locations 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 deposited at the designated regional or local stockpile would have to be proven to be chemically clean prior to deposition, and preferably already processed (screened of boulders/rocks, debris, trash, vegetation, and any other material incompatible with opportunistic beach fill). The stockpile site may be a suitable location to perform processing operations if sufficient space is available.

Two stockpile sites are designated as part of proposed opportunistic beach fill programs in San Diego County. Stockpile sites are planned for use at the El Corazon site in Oceanside and Saxony Detention Basin in Encinitas. These sites would supplement sediment management activities at opportunistic beach fill receiver sites at South Oceanside, Batiquitos Beach, and Moonlight Beach, respectively. 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 minimize costs of leasing the land from private landowners. **Figure 32** shows example candidate stockpile locations within the region and include:

- 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;
- The Tijuana Estuary stockpile site; and
- Possibly inland areas of local cities.

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 should be kept physically separate and somehow labeled with signage or markings to identify the source and donor. All stockpiles would have to conform to Water Board requirements of storm water and erosion control. Costs to truck the stockpiled material to the coast could periodically be funded by the state or others as appropriate.

Figure 32- Examples of Potential Stockpile Locations

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**

  Sediment that deposits within protected areas inboard of the shoreline, such as coastal lagoons with open inlets and harbors, is lost to the littoral zone until it is removed and replaced seaward of the shore. This represents a sink of sediment that needs to be periodically managed or restored to the littoral zone to reduce losses to the region. It does not represent new sediment for nourishment from outside the littoral zone. The term for sediment management from these sources is maintenance dredging and it is a critical component of the coastal sediment budget.

  Littoral sand that deposits in the outer harbor areas of these protected, yet active perennially aquatic environments (lagoons and harbors) are generally well-sorted and of fairly uniform grain size. The sediment usually possess a higher percentage of sand and lower percentage of fines than terrestrial sand. This material generally represents optimum sand. 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 but can be on the fine end of sand gradation. The higher energy level of the littoral environment, even if protected, leads to deposition of the relatively larger and heavier sediment grains 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 not possess sandy sediments, and the sediments may be contaminated.

- **Wetland Restoration Material**

  Sediment that deposits in protected and inactive 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 (possess a greater diversity in grain sizes). 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 sandy sediment in lower layers of earlier formation and finer sediment in higher layers of more recent deposition. This material can potentially possess contaminants in these upper layers that are sometimes contributed from the watershed because they can more readily adhere to the silts and clays.

6.2.1
Availability and Timing

- **Maintenance Dredging Material**

  Maintenance-dredged material is available on a regular 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 seem to total up to approximately 700,000 cubic yards within the region for an order-of-magnitude estimate. They are more predictable in amount and frequency than other sources because they are delivered by a system with a fairly constant process of wave- and tidal-driven currents. Maintenance dredging work is typically done in the fall or spring seasons, and not in summer or winter to avoid the high beach use season and winter storms, respectively.

Table 8 – Estimated Annual Quantities of Sand 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 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	50,000 (estimated)	Harbor maintenance dredging
TOTAL	**661,400**	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, 9 and 10.

- **Wetland Restoration Material**

  Material from lagoon restoration is available on an infrequent basis such as by decade or over longer time periods. The quantities can 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** shows these and other estimates. They are less predictable in amount and frequency than maintenance dredging projects. Restoration work is typically done in the fall and winter seasons to avoid impacting sensitive nesting birds in spring and summer.

Table 9 - Periodic Quantities of Sand From Wetland Restoration Activities

Location	**Periodic Quantity (Cubic Yards)**	**Activities**
Buena Vista Lagoon	800,000	Future lagoon restoration
Batiquitos Lagoon	1,500,000	Lagoon restoration in 1995
San Elijo Lagoon	800,000	Future lagoon restoration
San Dieguito Lagoon	60,000	Future channel restoration
Los Peñasquitos Lagoon	Quantity undetermined	Future lagoon restoration
San Diego Bay	Quantity undetermined	Future restoration
Tijuana Estuary	600,000	Future restoration
TOTAL	**3,660,000**	**Not Applicable**

6.2.2 Transportation

Material generated in an aqueous environment is dredged and discharged by slurry line by virtue of the fact that it is already in water. This mode of transport is unobtrusive and less impacting to the surrounding environment compared to truck trips. It is an efficient and inexpensive way to convey sediment, while being relative invisible.

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” and/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 sandy sediment within the littoral zone for as long a time period as possible, and for it to travel over as much of the length of the littoral zone as possible before it is lost to the littoral cell. Therefore, more study of sand transport direction is needed in the vicinity of each specific inlet/entrance channel to identify site-specific patterns. Net longshore sediment transport in the North County San Diego region is generally to the south at a rate of approximately 275,000 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 possess only one lagoon entrance and it is at the far end of the littoral cell.

Another consideration should be the existence of lagoon-subcells identified by Scripps 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 sediment longshore transport is interrupted and deflected offshore at the locations of lagoons. Sand placement near lagoons should be done considering implications of these data 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 lagoon subcells.

This Coastal RSM Plan recommends placing material relative to preserving 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 capitalize on longshore transport rates to reduce return to lagoons or harbors. Also, providing as much distance as possible between the placement sites and source lagoons/harbors will reduce return flows. See **Figures 33 through 37** of San Diego County maintenance operations. Proportional sand placement scenarios are offered in **Table 10** below as Coastal RSM Plan 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 the Table 10 as "existing" or "historical," and new recommendations are noted as "new" in the Placement Location column.

Table 10 - Proportional Placement of Sand from Local Dredge Projects

Dredge Location	Annual Quantity (Cubic Yards)	Placement Location
Maintenance Dredging/Excavation Projects		
Oceanside Harbor	222,000	On-beach 100% south of Tyson St (existing); alternatively Oceanside nearshore for less than optimum sand (new)
Del Mar Boat Basin	2,500	On-beach 100% at South Oceanside (new)
Agua Hedionda Lagoon	300,000	On-beach 60% south of entrance, 40% north of entrance (new)
Batiquitos Lagoon	25,000	On-beach with 60% south of entrance, 40% north of entrance (new); alternatively nearshore for less than optimum sand (new)
San Elijo Lagoon	25,900	On-beach 100% south of entrance (existing); alternatively nearshore for less than optimum sand (new)
San Dieguito Lagoon	16,000	On-beach 60% south of entrance, 40% north of entrance (new)
Mission Bay entrance channel	Undetermined, but estimated to be relatively small (10,000 assumed)	On-beach 100% north of entrance (historical)
Lower San Diego River (mouth area in Ocean Beach)	Undetermined, but estimated to be relatively small (10,000 assumed)	On-beach 100% south of entrance (new)
San Diego Bay	50,000	On-beach 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 on-beach for optimum sand; Oceanside nearshore for less than optimum sand
San Elijo Lagoon	800,000	On-beach 45% north of entrance, 55% south of entrance; Cardiff nearshore for less than optimum sand
San Dieguito Lagoon	60,000	On-beach 60% south of entrance, 40% north of entrance; Del Mar nearshore for less than optimum sand
Los Peñasquitos Lagoon	Quantity undetermined	On-beach 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	On-beach 60% north of entrance, 40% south of entrance; and nearshore Imperial Beach for less than optimum sand

Figure 33– Existing Maintenance Dredging Operations (North County)

Figure 34 – Existing Maintenance Dredging Operations (North Central County)

Figure 35 – Existing Maintenance Dredging Operations (Central County)

Figure 36 – Existing Maintenance Dredging Operations (South Central County)

Figure 37 – Existing Maintenance Dredging Operations (South County)

6.2.4
Habitat Considerations

Proportional placement has the potential to minimize potential impacts to biological resources 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 placement of optimal and less than optimal sands are further described previously in Section 6.1.

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 (costs) to the sediment discharger. The existing practice of sand placement is shown in **Table 11** below, with new proposed nearshore placement sites to provide flexibility for lagoon and harbor maintenance. New placement location recommendations are labeled as “new” in the right hand column.

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

Dredge Location	**Annual Quantity (Cubic Yards)**	**Placement Location**
Maintenance Dredging/Excavation Projects		
Oceanside Harbor	222,000	On-beach 100% south of Tyson St (existing); alternatively Oceanside nearshore for less than optimum sand (new)
Del Mar Boat Basin	2,500	On-beach 100% at South Oceanside
Agua Hedionda Lagoon	300,000	On-beach 40% south of entrance, 60% north of entrance
Batiquitos Lagoon	25,000	On-beach with 50% south of entrance, 50% north of entrance; alternatively nearshore for less than optimum sand (new)
San Elijo Lagoon	25,900	On-beach 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)	On-beach 100% north of entrance
Lower San Diego River (mouth area in Ocean Beach)	Undetermined, but estimated to be relatively small (> 10,000)	On-beach 100% south of entrance
San Diego Bay	50,000	On-beach 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 on-beach for optimum sand (new); Oceanside nearshore for less than optimum sand (new)
San Elijo Lagoon	800,000	On-beach 45% north of entrance, 55% south of entrance; Cardiff nearshore for less than optimum sand (new)
San Dieguito Lagoon	60,000	On-beach 60% south of entrance, 40% north of entrance; Del Mar nearshore for less than optimum sand (new)
Los Peñasquitos Lagoon	Quantity undetermined	On-beach 60% south of entrance, 40% north of entrance; Torrey Pines nearshore for less than optimum sand (new)
Tijuana Estuary (Phase 1)	600,000	On-beach 60% north of entrance, 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, potential inclusion of nearshore sites may improve lagoon maintenance schedules by providing nearby sites to receive less than optimal sands. Excessive sedimentation reduces habitat quality within lagoon and harbor habitats and is controlled with periodic maintenance dredging and/or excavation. Although considered less than optimal for placement on the beach, grain size characteristics of less than optimal sands are within the range of the lower beach profile and required to be free of contamination to ensure compatibility with beneficial use objectives. Habitat considerations associated with placement of optimal and less than optimal sands are further described previously in Section 6.1.

6.2.7
Placement Designs

The main types of material placement consist of:

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

Each transport mode is described in greater detail in the SCOUP report (Moffatt & Nichol 2006). On-beach placement is in the form of a level beach berm over the high and dry area of the existing beach by earthmoving equipment, and then sloping seaward at a certain point toward the water. It can also include surfzone placement along the low water line using earthmoving equipment in a low dike or mound that is reworked and redistributed naturally by subsequent 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 that deposits in the offshore ocean and outside of the active littoral cell can consist of relic depositional layers of drowned river valleys or offshore losses during extreme storm wave events. This material has been previously lost from the littoral cell and will remain sequestered until it is removed and replaced within the littoral zone. It represents a historic sink of sediment that is a large-scale supply of new sediment from outside the littoral cell available for nourishment.

The term 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 the first Regional Beach Sand Project constructed in 2001 and investigated in years preceding the construction (Sea Surveyor 1999; Noble Consultants 2000).

SANDAG plans to use this as their primary source for their RBSP II in 2011 or 2012. Research into sand deposits offshore of San Diego has continued since the RBSP I by various groups and potential sources additional to those used by SANDAG 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 for any projects they perform in North and South County as well.

Littoral sand that deposits in the relatively quiet areas farther from shore can be well-sorted and of 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 representing recent deposits. Existing data indicate the sandy sediment possesses a higher percentage of sand and lower percentage of fines than upland sand (Alpine 2008). This material represents optimum sand. It varies from being relatively fine in median grain size (at site SO-5 offshore San Dieguito Lagoon) to being fairly coarse (at site MB-1 off Mission Beach). Therefore, sediment dredged from offshore is of high quality for beach nourishment. The sandy sediment layers tend to be clean of contaminants because there are no recent sources of contaminants and contaminants do not adhere well to sand grains.

6.3.1
Availability and Timing

Sand from offshore is always available, but the relatively high costs of offshore dredging are a constraint that reduces the frequency of projects. They are typically performed from every five to ten years depending on the availability of funding. For example, SANDAG's RBSP I occurred in 2001 and RBSP II may occur in 2011 or 2012.

There are many source locations for offshore sand in the San Diego region. SANDAG previously investigated the sites labeled as SO in North County and MB off Mission Beach 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-spring and may extend through summer to capitalize on quiet ocean conditions for dredging and beach filling. Schedules may be restricted and/or additional construction monitoring required between March and September 30 depending on proximity to nesting areas of California least tern and/or snowy plover, and to maintain recreational uses.

Coordination needs to occur between SANDAG and the USACE for their respective large-scale offshore dredging projects. Both agencies 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 not known due to federal budget constraints. It may be necessary for SANDAG to perform their work while this Coastal RSM Plan process continues, and for monitoring data for the SANDAG project to inform any future USACE efforts. The USACE can consider both the SANDAG monitoring results, the latest sand placement operations of other sand sources, 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 on-beach sites utilized in RBSP I, plus some additional nearshore sites. The RBSP I site boundaries are referenced in this document; however, it should be noted that SANDAG intends to review and possibly modify the footprints of some sites to improve performance and/or further minimize potential environmental effects based on monitoring results and/or new information since that project was completed. 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. They may also allow for reduced potential cumulative impacts from multiple placements. The recommended nearshore sites are considered appropriate because these nearshore areas are not environmentally sensitive and enable sand placement while minimizing cumulative impacts to sensitive resources. These sites can receive fairly large quantities of sand in less frequency placement projects, as occurs for dredging because it is relatively high cost. **Figures 38 through 40** show the following examples of potential receiver sites for offshore sand:

1. South Oceanside on-beach;
2. South Oceanside nearshore;
3. North Carlsbad on-beach;
4. South Carlsbad on-beach;
5. Batiquitos Beach on-beach;
6. Moonlight Beach on-beach;
7. Cardiff Beach on-beach;
8. Fletcher Cove on-beach;
9. Del Mar on-beach;
10. Torrey Pines on-beach;
11. Mission Beach on-beach;

12. Mission Beach nearshore;
13. Coronado Beach on-beach;
14. Coronado Beach nearshore; and
15. Imperial Beach on-beach.

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 Oceanside feeding North County beaches and Imperial Beach feeding South County beaches. Oceanside serves as a feeder beach to North County because longshore sediment transport is north to south and it is located at the north end of the littoral cell. That is the rationale for including both on-shore and nearshore placement sites at Oceanside that accommodate large quantities of material. Similarly, the Imperial Beach placement site consists of both on-shore and nearshore placement areas to accommodate large quantities to feed the coast to the north, as the net longshore drift is south to north at that location.

Figure 38 – Offshore Sand Receiver Sites (North)

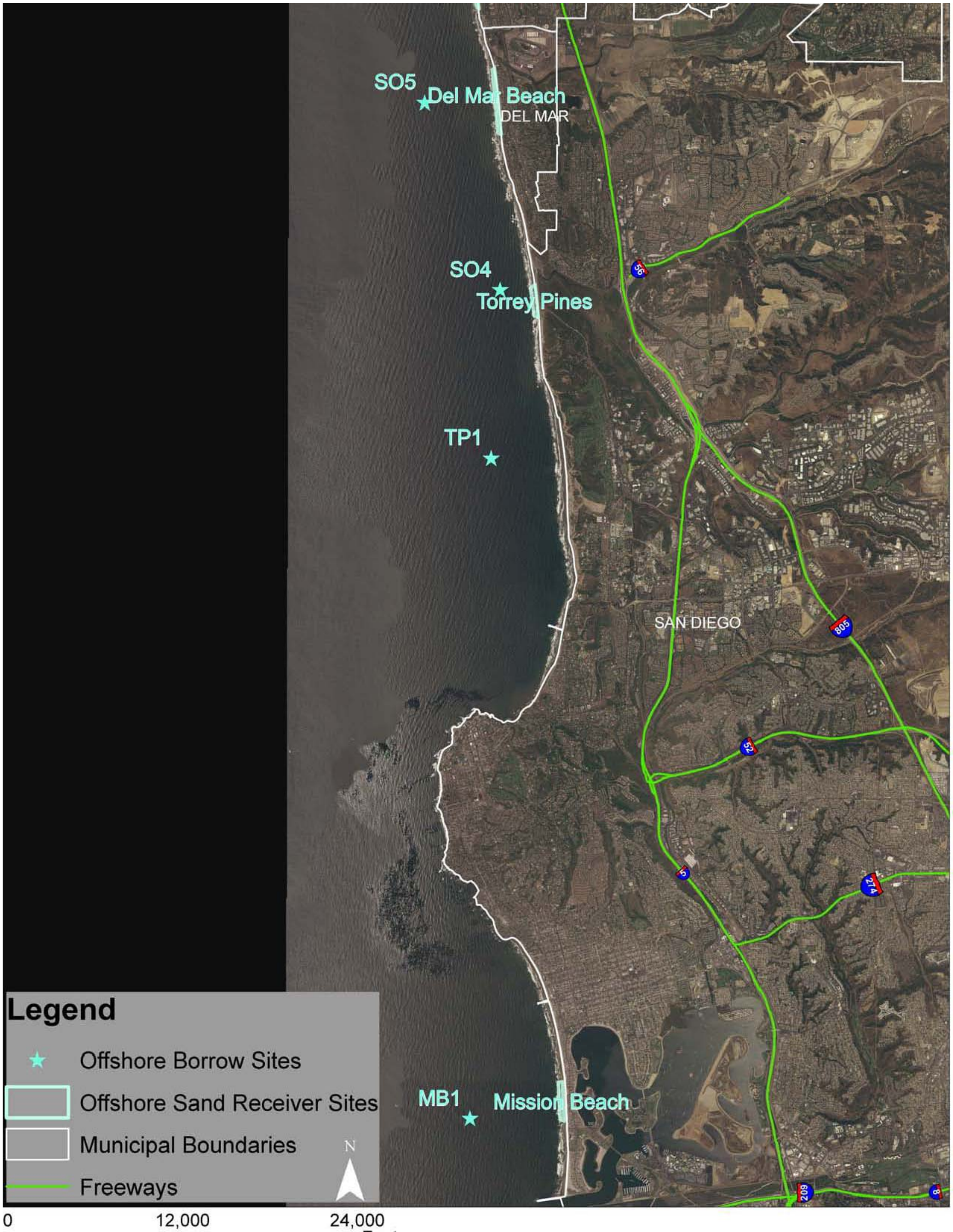


Figure 39 – Offshore Sand Receiver Sites (Central)

Figure 40 – Offshore Sand Receiver Sites (South)

6.3.4
Habitat Considerations

Previously used beach receiver sites are recommended due to success of RBSP I at minimizing impacts, with new nearshore sites added to provide for more flexibility and cost reductions. 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 sites near sensitive resource areas.

Sufficient sand 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 sand 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 and potential damage and/or disturbance of biological resources from operation of the dredge equipment and vessel anchoring. Other impacts are associated with sediment re-suspension and turbidity. Primary issues of concern include 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, water quality, and/or recovery rates;
- Proximity to sensitive aquatic habitats (e.g., reefs, kelp forests/beds);
- Proximity to spawning grounds and/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). Generally, relatively shallow versus deep pits minimizes the potential to change hydrodynamics and promotes recovery rates of benthic invertebrate forage base for secondary consumers (e.g., fish). Incorporating undredged refuge areas in the design of borrow site use also may speed recovery of the invertebrate forage base.

Potential turbidity and/or sedimentation effects are primary considerations with 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.

Limited information is available on nursery and/or spawning areas of commercial and recreation fishery species. Therefore, 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.

6.4 By-Passing of Offshore Sand from MCB 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. Over time, this fillet extended farther upcoast as deposition continued to the present. The fillet is so long that it reaches 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 is directly from the high energy portion (surfzone) of the littoral cell. 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 site is in proximity to a military base that can serve as a source of munitions or other contaminants.

This material would have been transported south into the southern littoral cell had the jetty not retained it. Therefore, it represents a historic sink of sediment that is also a large-scale source of new sediment from outside the southern Oceanside Littoral Cell that would be available for nourishment. Sand bypassing from this fillet could potentially serve as one of the most 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 conducted new offshore investigations in late 2008 for their regional project and investigated this source and found it to be suitable to good for nourishment.

6.4.1 Availability and Timing

Sand from this nearshore source could be removed by dredge and transported around the Harbor downcoast to replenish the southern littoral cell. A very large quantity is available in this area, but constraints could be placed on acquiring the material from MCB Camp Pendleton. Initial discussions between SANDAG and MCB Camp Pendleton officials have occurred to identify possibilities of bypassing the sand. MCB Camp Pendleton initially indicated that operational restrictions need to be considered and the dredge site should be placed just north of the Santa Margarita River mouth.

Dredging of the nearshore zone is typically undesirable because it can "rob" sand from moving downcoast. However, in this instance the downcoast site is the north harbor jetty which would not be negatively impacted by removing this sand because it is a stable structure. Therefore, removal of this nearshore sand could theoretically occur without downcoast impact, and could provide the positive effect of reducing shoaling at Del Mar boat basin and Oceanside Harbor. This sediment removal would result in a bathymetric depression that should back-fill rather quickly from subsequent longshore sediment transport from upcoast, due to the relatively high longshore sediment transport rates estimated for this reach of coast (USACE 1990 and 1991). Thus, this sand bypassing action could result in creation of a "sand trap" that could be mined for high quality sand on a regular basis to feed sand downcoast of the harbor and nourish the region.

Sand bypassing 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 sand bypassing concept is shown in **Figure 41**. This activity should occur in late spring and through summer to experience 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 is typically fairly low because of the anticipated larger sediment grain size.

6.4.2 Transportation

Sand 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).

6.4.3 Receiver Sites

Receiver sites from a nearshore sand trap to serve as feeder beaches are expected to be those closest in proximity to the source to reduce costs, and at the upcoast end of the southern Oceanside Littoral Cell to increase benefit and travel time through the cell. These sites include:

- South Oceanside Beach on-beach; and
- South Oceanside Beach nearshore.

Figure 41 – Oceanside Nearshore Sand Bypassing Concept

6.4.4
Timing of Nourishment

Sand bypassing can be done on an as-needed basis to supplement nourishment from other sources. If insufficient sand volume is placed over a year from opportunistic projects to meet the annual goal, then the balance could be made up by bypassing as an alternative to offshore dredging. The bypassing option may pose advantages of typical ocean dredging in that it is shallower, sandier, and relatively close to the nearest receiver site.

Sand bypassing could potentially be 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 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 "around" larger SANDAG projects and other efforts such as those of the USACE.

6.4.5
Habitat Considerations

Dredging of nearshore sand has the potential to disturb and/or degrade the subtidal habitat depending on frequency and potential to alter local hydrodynamics within the excavated area. Essential fish habitat uses of the sandy shoals by shellfish (e.g., Pismo clam bed) and/or as nursery habitat by commercially important fish (e.g., California halibut) should be assessed. 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 and/or turbidity). Habitat considerations associated with placement of sands are further described previously 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 terrestrial opportunistic sand sources, coastal maintenance and/or restoration, or sand from offshore dredging, in order 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 as nourishment concurrently over time, rather than exclusive use of one type of source. This nourishment will be occurring during time periods when lagoon and harbor maintenance dredging is also occurring. Therefore, coordination of nourishment activities may be needed to apply sand to the region more evenly over time and space to maximize natural sand 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 sand sources are shown in **Table 12** and in **Figures 42 through 46**. The figures show:

- Proposed RSM sites for sand nourishment from outside the littoral zone as yellow polygons, and
- Lagoon restoration and lagoon/harbor maintenance sites for proportional placement of sand from the littoral zone as green polygons.

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

Site ID Number	Receiver Sites (New Sites and Changes to Existing Ones are Indicated)	Probable Source(s)
1.	South Oceanside on-beach (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, upland, Buena Vista Lagoon restoration, bypassing, offshore
3.	North Carlsbad on-beach	Offshore, Buena Vista Lagoon restoration and maintenance
4.	Agua Hedionda on-beach (north, central, and south footprint sites)	Agua Hedionda Lagoon maintenance
5.	South Carlsbad on-beach	Offshore and upland
6.	Batiquitos Beach on-beach	Offshore, upland, Batiquitos Lagoon maintenance
7.	Batiquitos nearshore (new site)	Batiquitos Lagoon maintenance
8.	Leucadia	Offshore
9.	Moonlight Beach on-beach	Offshore, upland
10.	Cardiff Beach on-beach	Offshore, upland, San Elijo Lagoon restoration and maintenance
11.	Cardiff nearshore (new site)	San Elijo Lagoon restoration
12.	Fletcher Cove on-beach	Offshore, upland
13.	San Dieguito Lagoon nearshore (new site)	San Dieguito Lagoon ocean channel restoration
14.	San Dieguito Lagoon on-beach (new site)	San Dieguito Lagoon maintenance
15.	Del Mar on-beach	Offshore
16.	Torrey Pines on-beach	Offshore, upland, Los Peñasquitos Lagoon restoration and maintenance
17.	Torrey Pines nearshore (new site)	Los Peñasquitos Lagoon restoration
18.	Mission Beach on-beach	Offshore
19.	Mission Beach nearshore (new site)	Mission Bay, offshore
20.	Ocean Beach on-beach (new site)	upland
21.	Coronado Beach on-beach	upland

(cont.)

22.	Coronado Beach nearshore	San Diego Bay, offshore
23.	Imperial Beach on-beach	Offshore, upland
24.	Imperial Beach nearshore north	San Diego Bay, offshore
25.	Imperial Beach nearshore south (enlarged from USACE site)	San Diego Bay, Tijuana Estuary, offshore
26.	Border Field State Park on-beach	upland – debris basins

The entire network of placement sites constitutes those of the Coastal RSM Plan for San Diego County. Proposed RSM placement sites (yellow polygons) include both existing sand placement sites used for previous projects, and proposed new sites that would add flexibility to RSM efforts. Existing lagoon restoration and lagoon/harbor maintenance sites for proportional placement (green polygons) are not changed from present use, but represent locations where proportional placement of sand should be considered to reduce return of sand to lagoons/harbors after restoration and/or 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 Beach and are therefore colored as yellow overlaid with green.

A total of 26 possible placement sites are incorporated into this Coastal RSM Plan to enable the greatest flexibility in sand management. The majority of the sites have been used previously for sand placement and some footprints have been enlarged to accommodate more sand. Seven new sites are nearshore placement sites (off South Oceanside outside of a previous USACE placement area, off Batiquitos, off Cardiff, off San Dieguito Lagoon, off Torrey Pines, off Mission Beach, and off Coronado). The new sites are proposed for consideration to maximize environmental sensitivity of long-term sand placement within the region by spreading the placed sand volume over more numerous and larger areas to reduce cumulative impacts (the probability of burial of sensitive resources, and to reduce turbidity near bird nesting/foraging areas).

Modifications to some on-shore 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 sand, and for placement at different locations than occurred in RBSP I. Therefore some of the placement locations shown in this document may change from the Draft to Final versions of the Coastal RSM Plan.

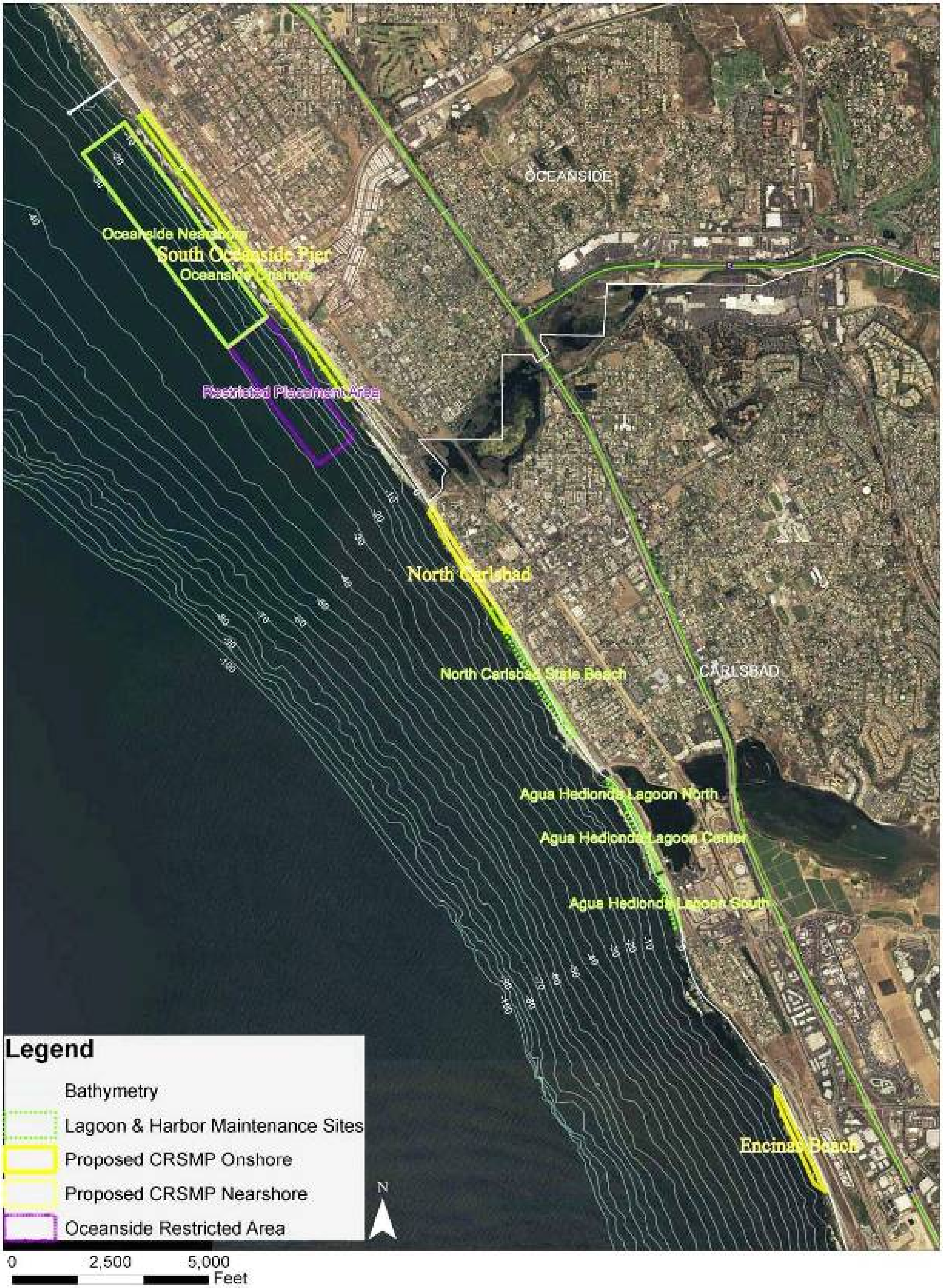


Figure 42 – North County Regional Receiver Sites

Figure 43 – North Central County Regional Receiver Sites

Figure 44 – Central County Regional Receiver Sites

Figure 45 – South Central County Regional Receiver Sites

Figure 46 – South County Regional Receiver Sites

6.5.2
Timing of Nourishment

Nourishment should be coordinated to eliminate large sand pulses, and associated resource impacts and potential large-scale losses from storms. Sand should be applied to the region more evenly over time and space as opposed to periodic spikes to maximize natural sand retention and environmental sensitivity in the region and minimize cumulative impacts. In contrast, periodic spikes of high sand input lead to higher sand 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.

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, 6.3.4, 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 and/or minimize impacts, including restrictions on volumes, frequency, timing, and/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 forage base for secondary consumers (fishes and shorebirds). Borrow site use also may be designed to facilitate recovery and protection of the benthic forage base by incorporating undredged 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 cumulative impacts and reducing conflicts.

Enhancing functional quality of beaches in erosive areas and providing more persistent quality habitats for biological resources is an important objective of the sediment management strategy. Sand placement that contributes to more persistent sand 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 a random set of unrelated actions that occur sporadically over time and space. Existing practices tend to show a pattern when analyzed comprehensively. **Tables 13, 14, and 15** show existing nourishment projects, quantities and timing that have actually occurred and been documented since 1993 (Coastal Frontiers 2007), and projected activities out into the future to 2015 based on these existing patterns. SANDAG plans an RBSP II in 2011 or 2012 that is included. The purpose of showing this information is to clarify the amount of sand placed over time within each littoral cell, and to compare that against the target rate needed to meet SANDAG's goal of increasing the sand volume in the region by 30 million cubic yards (SPS 1993). The targeted nourishment rate and timing is shown compared to existing rates, with recommended future nourishment rates indicated. Alternatives for management should focus on the goal of 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 as possible alternatives.

Nourishment in each alternative is assumed to come from outside the littoral zone. Specific receiver sites are presented in following sections of this report. Sites are conceived considering possible implications of ongoing work being done by SIO researchers on mini-littoral subcells within North County San Diego (O'Reilly, Personal Communication 2008), with more located away from lagoons than immediately adjacent to them.

The alternatives are presented relative to sand management devices. Sand management with devices refers to modification of a site sufficiently to cause sand to remain in place longer than would otherwise occur using some sort of device. Structural sand management devices consist of reefs that are both submerged and emergent from the water surface, 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 sand management devices, although a possible scenario is provided for consideration. Long-term management of the region's shoreline is much more cost-effective using management devices versus not using such devices (Moffatt & Nichol 2001; SANDAG internal documentation 2007; Everts 2002; California State Coastal Conservancy 2002). More sand is required for regional management over the long-term without sand management devices.

While the concept of using sand management devices is more economical over the long-term, it presents challenges of potential environmental impacts, social acceptance, high initial costs, and engineering. These issues pose serious considerations for this approach, but it can be implemented sensitively in San Diego County. San Diego County already possesses existing sand management devices presented in the Regional Sand Retention Strategy that can be viewed as examples. SANDAG is actively investigating the opportunities for using sand management devices as part of their ongoing RBSP II.

Sand management devices are not necessarily assumed to occur within the region, however they are included in two RSM options presented here to remain within the universe of options for analysis and consideration. Assumptions made for the sand management devices component of this plan are that sand management devices are installed at multiple sites that exhibit the need (are experiencing acute erosion), would benefit adjacent beaches, and would not result in a significant adverse environmental impact.

The range of possible sand management device scenarios is extremely broad and as yet undetermined. SANDAG is considering performing extensive analyses of potential sand management devices with input from regional stakeholders in the relatively near future to clarify possibilities. Locations of sand management devices and nourishment sites need to consider research being done by SIO (O'Reilly 2008) on lagoon subcells of sand 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 sand 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 for a submerged reef concept due its advantages of being less obtrusive to views and potentially beneficial to surfing and habitat, 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 SANDAG has initiated those efforts and plans to expand on them, contingent on funding assistance from the state.

All sand management devices include sand for pre-fill to prevent downcoast impacts. Existing natural and artificial sand 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 emergent above water 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 exists in Denmark and Sweden, with plans for pilots in Florida, and 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 the western California, so they are not considered as options in this plan.

Table 13 – Approximate Planned and Actual Sand 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 - 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 Sand 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 - 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 Sand 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 - 0.25 MCY
	0 - <0.25 CY
	0 CY

TARGET - NO RETENTION = 1 MCY/YR

TARGET - WITH RETENTION = 0.5 MCY/YR

7.1 One Million Cubic Yards Per Year Without Sand Management Devices

In the absence of sand management devices, a minimum of 1 million cubic yards of sand per year would be needed to lead to recovery of the beaches in the region over approximately half a century, accounting for estimated dispersion and/or losses. More sand is required to restore the region without sand management devices to account for losses of sand to the downcoast and offshore areas. For purposes of proposing possible scenarios, two different types of sediment sources are considered.

7.1.1
Maximum Opportunistic Beach Fills and the Balance from Offshore Dredging

In one scenario, it is assumed that existing and foreseeable opportunistic beach fill programs throughout the region are active to a maximum extent over their 5-year permit periods. If all opportunistic beach fill programs result in their maximum permitted amounts of sand placement each year, a total of 895,000 cubic yards of sand per year would be input to the region's coast as shown in **Table 16.** Of this, a general maximum of 25 percent fine-grained materials is also 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 sand receiver sites could be added to existing programs or as a new program associated with this Coastal RSM Plan. If that were to occur, then both the gross and net quantities of terrestrial sand available to nourish the region if all sites were filled to their permitted maximum would be 1,345,000 cubic yards of sand per year and 998,750 cubic yards of sand per year, respectively.

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

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

In the absence of establishing new opportunistic beach fill sites, the balance of sand 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 of annual nourishment needed from offshore sources to supplement opportunistic beach fill programs 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 sand provided from both terrestrial and offshore sources.

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

Receiver Site	Quantity (cubic yards)	Less 25% Fines for Terrestrial Sand
South Oceanside	150,000	112,500
South Oceanside Nearshore	150,000	112,500
North Carlsbad	250,000	250,000
South Carlsbad	150,000	112,500
Batiquitos Beach	120,000	90,000
Batiquitos Beach Nearshore	150,000	150,000
Moonlight Beach	150,000	112,500
Cardiff Beach	100,000	100,000
Cardiff Nearshore	150,000	150,000
Fletcher Cove	150,000	112,500
Del Mar Beach	120,000	120,000
Torrey Pines Beach	150,000	150,000
Torrey Pines Nearshore	150,000	112,500
Mission Beach	100,000	75,000
Mission Beach Nearshore	100,000	100,000
Coronado Beach	100,000	75,000
Coronado Nearshore	100,000	100,000
Imperial Beach	75,000	56,250
Imperial Beach Nearshore	75,000	75,000
TOTAL	**2,490,000**	**2,166,250**

Sources of upland sand are numerous and widespread in distribution. It is assumed that terrestrial sand will come from upland areas within 20 miles of the coast, and probably much closer. Sources of offshore sand are less numerous and located at distinct sites. It is assumed that offshore sand would come from the sources previous used by SANDAG, and possible new ones to nourish the North and South County.

Upland sand would be delivered primarily by truck over the existing road network. Offshore sand would be delivered by dredge using either hopper or hydraulic types.

7.1.2
All From Offshore Dredging

The other scenario for beach nourishment without sand management devices assumes that opportunistic beach fill programs are not productive and result in no sand contribution to the coast. Under this scenario, all sand 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) to keep mobilization costs down. Sand sources would be all possible offshore sites identified by SANDAG and others.

7.1.3
Summary of Performance Without Sand Management Devices

Nourishment under existing conditions without sand management devices requires a higher nourishment rate over time and larger quantities, but without a significant structural investment initially. Thus, the project costs more over the long-term, takes longer to accomplish the goal of adding 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 sand management devices. Short-term costs are lower under this scenario compared to the with-sand-management devices scenario due to no structural investment.

7.1.4
Habitat Considerations

Habitat considerations associated with coordinated sediment management activities involving a variety of sand sources include those previously described and summarized in Section 6. An important objective of sediment management planning is to guide sand placement to address coastal erosion and deficit concerns in a way that avoids and minimizes impacts to sensitive habitats and resources. Dredging and sand placement are disruptive activities with unavoidable effects to essential fish habitat. Depending on work location and/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 and/or wintering concentration areas for some endangered and/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 to address unavoidable significant effects depending on implemented alternatives.

Sediment management strategies that vary according to different volume and sand source combinations (e.g., opportunistic, maintenance dredging, and offshore sand) 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 and/or CEQA/NEPA document subject to public comment and resource and regulatory environmental review and permitting.

7.2 One Half Million Cubic Yards of Sand Per Year with Sand Management Devices

With sand management devices, less sand would be required to nourish the region annually because less sand would be lost from the littoral cell. For purposes of this plan it is assumed that sand management devices would reduce the annual nourishment rate by approximately 50 percent. This reduction in the nourishment rate from the effects of sand retention is an educated guess and certainly open to debate, justification, and modification. Therefore, up to 500,000 cubic yards of sand would be needed each year to restore the beaches in the region over approximately half a century. Similar to the project scenarios without sand management devices, the two different types of sediment sources are considered, including upland and offshore sands.

7.2.1 Sand Management Devices at Appropriate Sites and all Sand from Opportunistic Beach Fill

In the upland sand 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 opportunistic beach fill programs result in their maximum permitted amounts of sand being placed each year. Further, if all materials consist of up to 25 percent fine-grained particles, the net quantity of sand 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, opportunistic beach fill programs could entirely nourish the region's coast in the presence of sand retention under all of these assumptions.

7.2.2 Sand Management Devices with all Sand from Offshore Dredging

As with the no-sand-management devices option, one scenario considered for beach nourishment with sand management devices assumes that opportunistic beach fill programs are not productive and result in little or no sand contribution to the coast. Under this scenario, all sand 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. Sand sources would be all possible offshore sites identified by SANDAG and others.

7.2.3 Summary of Performance with Sand Management Devices

Nourishment under modified conditions with sand management devices would require a lower nourishment rate over time and smaller quantities for each project as compared to a scenario without sand management devices, but with a significant structural investment initially. Thus, the project costs less over the long-term, but more over the short-term for sand management devices. 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 sand management devices.

7.2.4 Habitat Considerations

Habitat considerations associated with coordinated sediment management activities involving sand retention include those summarized in Sections 6 and 7. In addition, there are additional impact considerations associated with construction and effects of sand management devices. Some effects would be limited to the period of construction of the sand 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 sand retention also apply to alternatives involving sand retention, other considerations are unique to sand 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 structure to provide habitat functions for biological resources. 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 concept for regional sediment management in the San Diego Region is nourishment with one-half million cubic yards of sand with sand management devices. This option 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 sand management increases the probability that the sand volume in the region can be increased over time without being lost during severe storm wave events. This option will also most likely reduce the time period and quantity of sand required over time to achieve the target volume increase. In addition, proportion placement of sediments from lagoons and harbors should occur to maximize the residence time of sand within the littoral cell and to reduce shoaling of these sites from sediment return.

8.0

ADDITIONAL CONSIDERATIONS OF ALTERNATIVES

Additional considerations to basic components of regional sediment management 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 Project Costs

Project costs included those for planning, engineering, construction, maintenance, monitoring/reporting, and potential mitigation. Cost estimates for the two major alternatives (nourish with and without sand management devices, and sub-alternatives of using upland and/or offshore sand are shown as annualized costs in Table 18 and in Appendix D. The CSBAT model was used in a limited manner for reference information to estimate project costs. Annualized costs are those required on a yearly basis to implement the project, perform on-going renourishment, and monitoring and maintenance. As shown in Table 18, the cost to construct alternatives with no sand management devices measures ranges from $18 million using only offshore dredged sand, to $37 million using only upland sand. In comparison, the cost to construct the alternative that includes sand management devices varies from between $16 million to $26 million, depending on whether offshore or upland sand sources are used.

The least expensive construction scenario is using offshore sand, 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 sand will decrease and become more in line with costs to dredge from offshore.

In 2007, SANDAG performed a separate cost estimate predicting a total 50-year project cost (SANDAG Internal Documentation 2007). SANDAG's result was that costs to nourish every five years without sand management devices would total $614 million, while the total cost to implement with sand management devices and nourishment every ten years (50% reduction in nourishment nourishment) would be $455 million. Thus, cost savings of $159 million, or 26 percent could be realized over 50 years by implementing sand management devices and nourishment compared to nourishment only.

8.3 Project Benefits

Project benefits include those from increased recreation from wider beaches, increased hard bottom habitat area, reduction of damage to infrastructure from increased shore/property protection, 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 (2007) that includes recreation and protection of public property. The CSBAT model was not used to estimate benefits because the model is focused on only 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, are estimated at approximately $18.7 million. This estimate is based on the benefits specified in the SANDAG Feasibility Study (2007) for the square footage of new beach created by either adding sand to the region at the target rate of 1 million cy/yr without sand management devices or adding 500,000 cubic yards per year of sand to the region every year with sand management devices (assumed to retain 500,000 cubic yards per year of sand).

Using these values, as shown in Table 18 the benefit to cost ratio for the project with no retention ranges from between 0.5 for the scenario of all terrestrial sand being used, to 1.0 for the scenario of all offshore sand being used. The most likely scenario would be some combination of the two sand sources. The benefit to cost ratio for the alternative that includes sand retention ranges from 0.7 using only terrestrial sand to 1.2 using only offshore dredged sand.

The benefits to costs are summarized in the matrix below. As indicated in the matrix, the most likely scenarios use a combination of different sand sources, so the range of benefit to cost (B/C) ratios is from 0.5 to 1.2. The lowest B/C ratio is for Alternative 1A (combination of sand sources without sand management devices) and the highest B/C ratio is for Alternative 4 (all offshore sand with sand management devices), respectively. If transport costs for upland sand can be reduced, then the benefit to cost ratios may all be larger than 1.0. The highest benefit ratios are realized when sand dredged from offshore 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**
Alternative 1A - No Mgmt Devices, 1 M CY/YR, upland (0% fines), offshore sand	$37,020,026	1,000,000	$18,740,321	0.5
Alternative 1B - No Mgmt Devices, 1 M CY/YR, upland (25% fines), offshore sand	$30,455,257	1,000,000	$18,740,321	0.8
Alternative 2 - No Sand Management Devices, 1 M CY/YR, offshore sand	$18,211,709	1,000,000	$18,740,321	1.0
Alternative 3 – Sand Management Devices, 500 K CY/YR, upland sand	$25,968,700	500,000	$18,740,321	0.7
Alternative 4 – Sand Management Devices, 500 K CY/YR, offshore sand	$15,707,571	500,000	$18,740,321	1.2

8.4 Possible Funding Sources

There are a number of possible local and regional sources that could be considered to help cover the funding requirements of the two alternatives. These possible funding sources include both existing and newly created funding sources. Existing funding sources include the state Ocean Protection Council and the CCC sand mitigation fund 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 funding sources 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 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) or it could be tied to other 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 since 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 stormwater 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 and/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 the impact of (beach) sediment transport through coastal watersheds to determine an appropriate cost sharing distribution.

8.4.7
Inland Sand Transport Offset Fund

The recent development of opportunistic sand programs (e.g., SCOUP) throughout San Diego County represents the first step in helping get sand from inland sources get onto the beaches of San Diego County. The next step is to implement these programs such that the beneficial use of suitable inland sand for placement on local beaches is considered as a viable option for excavation projects implemented within the coastal cities of San Diego County. The last step towards achieving the tangible goal of having suitable inland sand placed on the beaches of San Diego County is to provide the financial incentives necessary for project proponents (e.g., coastal cities) and implementers (e.g., developers) to actually do it. This is necessary because, in many cases, it will be more expensive for project proponents to place the suitable inland sand on local beaches then it would be to use the material for other purposes such as onsite fill or offsite fill. Project proponents may also find it more expensive to process and permit opportunistic use projects in comparison to these other options. Consequently, additional funding is necessary to offset these additional costs, thereby making it financially viable for project proponents and implementers to place suitable inland sand on local area beaches. A matching fund could be set up to cover the incremental costs associated with implementation of the opportunistic sand programs developed throughout coastal San Diego County. The matching fund could take many forms with several options 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

As indicated above, this fund could utilize existing and/or new funding sources, including the potential funding sources identified in Sections 8.4.1 through 8.4.6. Alternatively, this fund could be used as the basis for establishing a new funding source linked directly to the intent of this fund. 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 implementers to place suitable inland sand on local beaches by making it more expensive to do otherwise. Alternatively, the fee could be set at low to modest levels thereby allowing 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 Corps of Engineers to consult with NOAA National Marine Fisheries Service and the USFWS where necessary for Essential Fish Habitat (EFH) and Endangered Species Act issues. 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) and/or Consistency Determination.
- California State Lands Commission – Lease of State Lands for placement of sand below mean high tide line, which will include the requirement to perform a mean high tide line survey prior to the first placement and potentially re-surveyed 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 – Potentially, an Encroachment Permit will be required if the receiver site is located within a State Park.
- Local Agencies – A potential permit is 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, Coronado, and Imperial Beach. Solana Beach may possess the authority to issue CDPs by the beginning of 2009 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 rivermouth 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 project must be consistent with CEQA and NEPA through environmental review. A joint CEQA/NEPA document would likely be required in the form of an Environmental Impact Report/Environmental Impact Statement (EIR/EIS).

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.

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 without a long-term vision on a case-by-case basis. A few possible mechanisms for governance are presented in this section.

9.1 Options for Governance Structure for Implementation

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 made available 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 CEQA Initial Study Checklist

The California Environmental Quality Act (CEQA) requires each project to be analyzed for potential environmental impacts. The Initial Study (IS) checklist is an initial screening document that poses questions about potential impacts to resource areas that help the reviewer determine which level of environmental review may be required. Each jurisdiction typically uses a standardized IS form, or the form provided by the state. Questions about whether the project will 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." 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 sand useful for benefits at the coast, and what specific data are available about the sediment. The AEP has not yet concluded revision of the CEQA IS form.

9.1.2
Add to/Amend 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, practical limitations). The Coastal Act could be amended to require all projects within the coastal zone to be consistent with the Coastal RSM Plan, and to require that local agencies initiate actions to secure approvals for use of receiver sites.

9.1.3
Add to/Amend Local Coastal Plans

As with the state Coastal Act, existing Local Coastal Plans (LCPs) could also be amended to include specific reference to project proponents consulting the Coastal RSM Plan during conceptual project phases. Actual sediment management activities are implemented most frequently at the local level, and local policy documents should specifically relay instruction of how to carry out the Coastal RSM Plan for individual projects.

9.1.4
City/County Grading Permits

Local permits for construction could include requirements to implement sediment management activities if surplus sandy sediment exists from a project. To secure the permit, the local agency could require the applicant to consult the Coastal RSM Plan prior to formalizing their project to demonstrate consistency with the Plan or explanation of exceptions to the Plan for their project.

9.1.5
Incentives Through Reduced Developer Fees

Local agencies impose fees on projects being processed to secure all approvals. 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.

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. They could specify that the local agency 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.

9.1.7
Establish "Sediment Sheds/Littoral Cell" Planning Agencies

Establishment of "sediment shed" or littoral cell planning agencies that are analogous to watershed planning groups could further the initiatives of the CRSM Plan. The closest resemblance to this type of group is the SANDAG 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 benefit from more specific input from a subgroup that only addresses sediment management, and carries information and recommendations forward to the SPWG.

9.1.8
Regional General Permits

The USACE has issued Regional General Permit (RGP) #67 for opportunistic beachfill projects in Southern California. RGP 67 generally allows beach nourishment for projects that utilize at least 80 percent sandy material proven to be uncontaminated and proposed for placement below the high tide line. Requirements include a demonstrated need for the sand at the beach and sensitive environmental resources will not be impacted. This permit is also 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, and State Lands Commission to place sand 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 the plan from all agencies to allow for all elements of the plan to be carried out without the need for repeated permitting of each individual element. The permits should include the entire plan such that implementation can be streamlined for project construction.

9.2 Possible Impedances to Implementation

Obstacles to the reuse of surplus sediments at eroding coastal areas exist that may be avoided. Impediments include certain local, state, and federal policies, stakeholder interests, potential future regulation, existing economic disincentives, and practical project considerations. Examples of potential impediments 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.

- **Legislation**
  - Potentially prohibiting dredging and placement activities in the ocean - The Marine Life Protection Act being enforced by the California Department of Fish and Game presents a significant potential impedance to this effort if the CSMW and SANDAG are not actively involved and the MLPA process sets restrictions on nourishment without adequate information about its multiple benefits. Involvement should include participation in the MLPA process as stakeholders, information sharing with the MLPA Science Advisory Panel to clarify benefits of nourishment and results of SANDAG monitoring and recent research on habitat benefits (SAIC 2005), active review and comment on MLPA decisions, and all other options.
  - Eliminating sediment yield from the watershed – Future Total Maximum Daily Load (TMDL) regulations for sediment to be set by the Regional Water Quality Control Board (RWQCB) may reduce sediment delivery to the coast. SANDAG and the CSMW should actively work with RWQCB staff and Directors to promote sediment transport to the coast when considering TMDLs and sediment detention basin approvals; and
  - Stormwater Permits by the RWQCB requiring containment of all sediment on-site at development projects – This same process may reduce sediment load to the coast and that effect should be considered when the Board and State review the Stormwater Permit program.

- **Policies**
  - USEPA policy or "rule-of-thumb" that the material placed at the coast should not exceed the percentage of fine-grained sediments at placement site by not 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.

- **Stakeholder interests**
  - Concerns regarding adverse impacts to surfing and coastal resources – the Surfrider Foundation;
  - Preventing impacts to local fisheries – the Lobster Fisherman industry; and
  - Local citizen groups opposed to beach nourishment for various reasons such as concerns about the environment, economics, and health/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; and
  - Increased costs to truck material to the coast from inland construction sites.

- **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.

These impediments may be avoided and/or proactively modified to enable regional sediment management. A concentrated effort should be made to coordinate among the various groups opposed to the Coastal RSM Plan, or that are enacting legislation that inadvertently opposes 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 if possible, along with the needs of the coast. A balance will need to be struck among the interests of the various groups and the needs of the coast. Federal, state, and regional leaders will need to strike this balance and continue to strive toward maintaining the balance as further development occurs throughout the region in the future in order to preserve the quality of life committed to by SANDAG.

10.0

MONITORING AND REPORTING

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

10.1 Impact Assessment/Performance Evaluation

Generally, the monitoring program may involve sediment sampling, beach profiles, surfing conditions, turbidity, and sensitive biological resources. Monitoring elements would be dictated by project-specific features such as schedule and/or placement method. The types of monitoring relative to the project phase are summarized in **Table 19**. These monitoring requirements are based upon the SCOUP Plan (M&N 2006) and monitoring implemented during the RBSP I (AMEC 2002, 2005). The monitoring objectives focus on avoiding and minimizing adverse effects during project implementation and verification of no significant adverse effects after implementation.

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

SANDAG presently monitors the beach through profiling for regional purposes, performed more detailed monitoring for RBSP I, and compiled an inventory of habitat. They will also perform monitoring of RBSP II. These efforts are all directly applicable and beneficial to implementation of this Coastal RSM Plan. The data can serve as the baseline for environmental review and permitting of the Plan.

10.2 Adaptive Management

The Coastal RSM Plan is a “living document” that will require periodic updates to add and/or to modify actions. The Coastal RSM Plan will be updated on a suitable basis (to be determined), or as necessary, using a collaborative process among 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 public review.

Table 19 - Overview of Monitoring Program

Project Phase	Timing/Duration	Type of Monitoring
Pre-project Baseline	1 month prior	Beach profiles
	1/2 month prior, 3 times per week over 14 days	Surf conditions
	If project is scheduled between March 1 and September 15 (2 to 3 weeks prior to construction before and/or during predicted grunion run closest to project initiation)	Grunion habitat suitability (if surf zone or berm placement) Grunion monitoring (if habitat suitable)
	30 days prior to project start	Nearshore sensitive resources; e.g., Pismo clam beds, giant kelp beds, surfgrass beds, nearshore reefs with sea fans, sea palms, and/or feather boa kelp (if nearshore placement)
During Construction	Daily during construction	Turbidity
	If scheduled between March 1 and September 15 (monitoring frequency dictated by tides and lunar cycle, approximately every 2 weeks during spawning season)	Grunion monitoring
	If scheduled between March 1 and September 15	Endangered and Threatened Species Western snowy plover (daily monitoring if receiver site is within critical habitat and/or adjacent to known breeding sites); California least tern (daily monitoring of turbidity outside surf zone if receiver site is adjacent to known breeding sites)
Post-Construction	Immediately after completion	Beach profiles
	1 month after, 3 times per week over 14 days	Surf conditions
	90 days after construction	Nearshore sensitive resources (if appropriate)
Post-Project	Over 1 year following construction; surveys at 6 months after; and 1 year after	Beach profiles
	Either 9 months or 1 year following construction, depending on biologist, with concurrence of permitting agencies	Nearshore sensitive resources (if appropriate)
Years 1 (pre-project), 2, 3, and 5	Summer	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)

Source: SCOUP Plan, 2006 and SAIC, April and September 2006.

11.0

DATA GAPS AND RECOMMENDED NEXT STEPS

Data gaps exist that need to be addressed prior to implementing successful regional sediment management. This effort was focused on collecting all available existing data and analyses to develop the Coastal RSM Plan. New data should be collected and new analyses performed to inform the sediment management effort. These new data and analyses are listed below. Next, the region will need to take a series of steps toward implementing the Plan throughout the region. Those "next 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 Coastal RSM Plan beaches (except those already characterized such as South Oceanside, Batiquitos Beach, Moonlight, Fletcher, Coronado, Imperial Beach, and Tijuana Estuary – these data are required to establish the grain size envelope for receiver beaches for any permit; and
- More complete and updated sediment source information throughout the region would be useful to prepare a standardized inventory/repository of data for targeting promising opportunities.

Additional analyses are also needed and include:

- On-going evaluation of the most recent longshore sediment transport data from the SIO CDIP program to determine appropriate proportional placement scenarios for lagoon maintenance;
- Integration of the mini sub-cell analysis being done by SIO into this Coastal RSM Plan;
- Estimation of environmental habitat benefits expressed as dollars for future benefit/cost analyses required for state grant funding;
- Evaluation of actual project performance as compared to model predictions to improve the models for future use;
- Quantification of the risk to sensitive reef areas from sedimentation, relative to sand placement volume and/or frequency;
- Effect of sand management devices on reducing future nourishment quantities, and shortening the time-frame needed to add 30 million cubic yards to the region;
- Continued evaluation of 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 (as performed by SANDAG for RBSPs I and II).

11.2 Recommended Next Steps – Short- and Long-Term

A series of steps are listed below that should be taken to carry out the plan. These steps are required over both the short- and long-term.

- **Short-Term Next Steps**

1. Continue education of the public on the need for regional sediment management.
2. Work with local agency staff to understand the need for the Coastal RSM Plan and develop strategies for them to integrate it within their jurisdictional authorities.
3. Prepare a programmatic CEQA/NEPA document for implementation.
4. Implement short-term Coastal RSM Plan measures such as:
   a. Indicate whether RSM receiver sites are acceptable, and/or revise previous SANDAG RBSP sites;
   b. Indicate any interest in sand management devices;
   c. Acquire sediment gradation data for receiver sites not sampled since 2005;
   d. Update list of possible sediment sources including location, quantity, and frequency of availability; and
   e. Update possible stockpile locations.
5. Update the Shoreline Preservation Strategy to include new information from the RBSPs and advances in science and technology since its adoption.
6. Conduct a feasibility study of installing railroad off-loading sites where appropriate as part of any double-tracking project to facilitate transport by rail.
7. Develop a first-order (shallow-level) regional sediment monitoring program to monitor all elements of the Coastal RSM Plan to provide updates. The program should be supplemented by more detailed, project-specific monitoring of the following to achieve more comprehensive and efficient monitoring to better implement projects:
   a. Lagoon sedimentation for maintenance dredging;
   b. Waves and longshore sediment transport;
   c. River discharge;
   d. Sedimentation/erosion along the coast using beach profiles;
   e. Nearshore reef conditions of sedimentation; and
   f. Effects on surfing.
8. Work with the RWQCB to promote transport of sediment to the coast when considering TMDLs and sediment detention basins.
9. Work within the MLPA initiative process to inform policy and decision-makers of the multiple benefits of nourishment documented by RSBP I.

10. Coordinate with each watershed manager to facilitate continued coastal sediment yield.

- **Long-Term Next Steps**

1. Establish at least an appropriate "sediment shed" authority to coordinate sediment availability and include their participation on the SPWG.
2. Integrate longshore sediment transport estimates from the SIO CDIP program into the living document data base, considering lagoon-subcells hypothesized by O'Reilly (2008).
3. Take a systematic approach to local agency implementation when projects are applied for, with City staff or the sediment shed authority performing the initial evaluation for candidacy.
4. Establish one or several RGPs 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.
5. 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).
6. Implement action steps by SANDAG such as:
    a. Install sand 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 sand for Fletcher Cove) after monitoring results are assessed.
7. Link watershed and sediment management planning in order to:
    a. Leverage federal and state funding; and
    b. Provide incentives to the private sector through reduced fees.
8. Create a secure funding stream by establishing a funding strategy.
9. Impose fees on dam owners that impound sediment for infrastructure maintenance and document local efforts as matches.
10. Utilize data from the pilot projects to update the RSM such as the Tijuana Estuary Fate and Transport Study.
11. Establish uniform monitoring procedures and implement strategic monitoring to support decision-making relative to adaptive management (e.g., optimizing sand

placement volumes and/or frequency in areas with sensitive resources) on a regional level.

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 coordinate multiple separate efforts and to realize sand placement quantity targets to restore the region's sediment supply. This Coastal RSM Plan is an explanation of several approaches to solve the problem of insufficient sand being delivered to the coast.

2. **Surplus Sediment**

   Surplus sandy sediment exists upland, in lagoons and harbors, and offshore.

3. **Critical Erosion Areas**

   Critical coastal erosion areas exist throughout the region from Oceanside to Imperial Beach.

4. **Alternatives to Counter Erosion**

   The overall Plan is to nourish the coast with sufficient sand quantities to overcome existing sand losses and reach a target of 30 million cubic yards added to the region over 50 years. Alternatives to counter erosion include facilitating sediment delivery from upland, placing lagoon sediments proportionate to longshore transport, dredging sand from offshore, and bypassing sand from upcoast of Oceanside Harbor. Specific sites to receive sediment from these various sources have been identified within this Coastal RSM Plan. Coordination by SANDAG and the USACE for offshore sand projects must occur.

5. **Sand Placement Quantities Assuming No Sand Management Devices**

   The recommended quantity of sandy sediment to be added to the coast is up to one million cubic yards per year if sand management devices are not assumed to be included. In different scenarios, sand sources can include both upland and offshore sand, or be composed of only offshore sand.

6. **Sand Placement Quantities Assuming Sand Management Devices**

   The recommended quantity of sandy sediment to be added to the coast is up to 500,000 cubic yards per year if sand management devices are included. In different scenarios, sand sources can be composed of either upland sand or offshore sand. The option of using sand management devices and placing 500,000 cubic yards of sand per year dredged from offshore is the preferred concept for this Coastal RSM Plan, along with proportion placement of sand from lagoons and harbors.

7. **Economics**

Project economics are favorable with a benefit to cost ratio higher than 1.0 for use of offshore sand without sand management devices, while the use of upland materials does not appear to be favorable as the benefit to cost ratio is lower than 1.0. Projects should focus on using offshore sand until a cost reduction for use of upland sand can be realized. Use of sand management devices result in a higher benefit to cost ratio of 1.2 and they reduce long-term costs compared to non-retention by 25 percent.

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 Development Permit's, and City/County Grading Permits; reducing developer fees; integrating the plan into Local Zoning Ordinances and General Plans; setting up "Sediment Sheds/Littoral Cell" Planning Agencies; and securing RGPs.

9. **Impedances to the Plan**

Impedances to the Plan include certain existing or future legislation, 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 of paramount importance to beach nourishment as regional sediment management. One process, the Marine Life Protection Act, can sufficiently restrict nourishment and offshore dredging as to render management ineffective. SANDAG, stakeholders, and the CSMW must actively participate in the MLPA process if regional sediment management is to successfully occur. The other process is development of Total Maximum Daily Loads (TMDLs) for sediment in the San Diego Region by the Regional Water Quality Control Board. This process can significantly restrict sediment delivery to the coast, and SANDAG and stakeholders need to also intercede, coordinate, and inform the TMDL process of benefits of regional sediment management.

10. **Monitoring and Reporting**

Integrate existing SANDAG monitoring and extend/modify it to provide adequate monitoring and reporting for biology, beach profiles, and lagoon shoaling to verify and refine the Coastal RSM Plan. 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.

- **Short-Term Next Steps**

1. Continue education of the public on the need for regional sediment management.
2. Work with local agency staff to understand the need for the Coastal RSM Plan and develop strategies for them to integrate it within their jurisdictional authorities.
3. Prepare a programmatic CEQA/NEPA document for implementation.
4. Implement short-term Coastal RSM Plan measures such as:
    a. Indicate whether RSM receiver sites are acceptable, and/or revise previous SANDAG RBSP sites;
    b. Indicate any interest in sand management devices;
    c. Acquire sediment gradation data for receiver sites not sampled since 2005;
    d. Update list of possible sediment sources including location, quantity, and frequency of availability; and
    e. Update possible stockpile locations.
5. Update the Shoreline Preservation Strategy to include new information from the RBSPs and advances in science and technology since its adoption.
6. Conduct a feasibility study of installing railroad off-loading sites where appropriate as part of any double-tracking project to facilitate transport by rail.
7. Develop a first-order (shallow-level) regional sediment monitoring program to monitor all elements of the Coastal RSM Plan to provide updates. The program should be supplemented by more detailed, project-specific monitoring of the following to achieve more comprehensive and efficient monitoring to better implement projects:
    a. Lagoon sedimentation for maintenance dredging;
    b. Waves and longshore sediment transport;
    c. River discharge;
    d. Sedimentation/erosion along the coast using beach profiles;
    e. Nearshore reef conditions of sedimentation; and
    f. Effects on surfing.
8. Work with the RWQCB to promote transport of sediment to the coast when considering TMDLs and sediment detention basins.
9. Work within the MLPA initiative process to inform policy and decision-makers of the multiple benefits of nourishment documented by RSBP I.

11. Coordinate with each watershed manager to facilitate continued coastal sediment yield.

- **Long-Term Next Steps**

1. Establish at least an appropriate "sediment shed" authority to coordinate sediment availability and include their participation on the SPWG.
2. Integrate longshore sediment transport estimates from the SIO CDIP program into the living document data base, considering lagoon-subcells hypothesized by O'Reilly (2008).
3. Take a systematic approach to local agency implementation when projects are applied for, with City staff or the sediment shed authority performing the initial evaluation for candidacy.
4. Establish one or several RGPs 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.
5. 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).
6. Implement action steps by SANDAG such as:
   a. Installing sand management devices;
   b. Optimizing implementation of the Coastal RSM Plan based on monitoring results; and
   c. Identifying the grain sizes best suited for certain sites (e.g., coarse sand for Fletcher Cove) after monitoring results are assessed.
7. Link watershed and sediment management planning in order to:
   a. Leverage federal and state funding; and
   b. Provide incentives to the private sector through reduced fees.
8. Create a secure funding stream by establishing a funding strategy.
9. Impose fees on dam owners that impound sediment for infrastructure maintenance and document local efforts as matches.
10. Utilize data from the pilot projects to update the RSM such as the Tijuana Estuary Fate and Transport Study.
11. Establish uniform monitoring procedures and implement strategic monitoring to support decision-making relative to adaptive management (e.g., optimizing sand

placement volumes and/or frequency in areas with sensitive resources) on a regional level.

13.0

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APPENDIX A

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 rece3iver sites, and sediment information of receiver sites and sources. Work done for the SCOUP will significantly apply to this task.

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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	kwo@sandag.org	✓
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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.

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SANDAG

Coastal Regional Sediment Management Plan

June 5, 2008 City of Encinitas

SIGN IN

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SANDAG

Coastal Regional Sediment Management Plan

June 5, 2008 City of Encinitas

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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.

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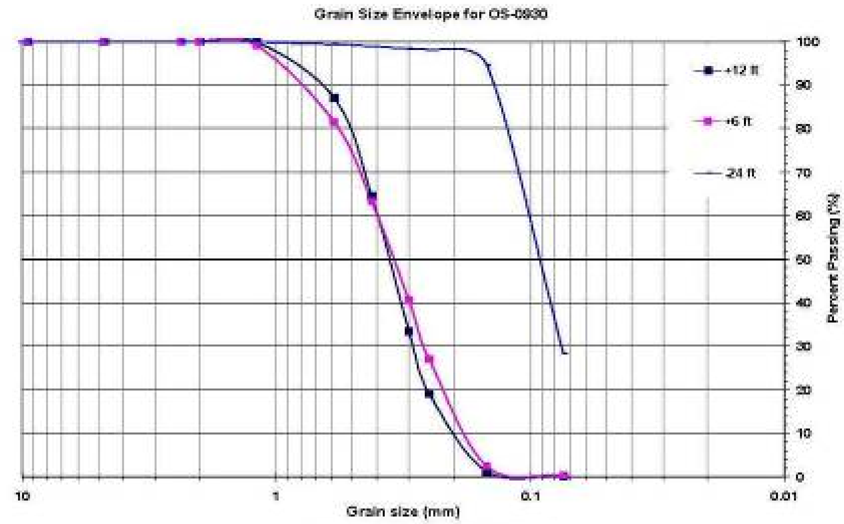
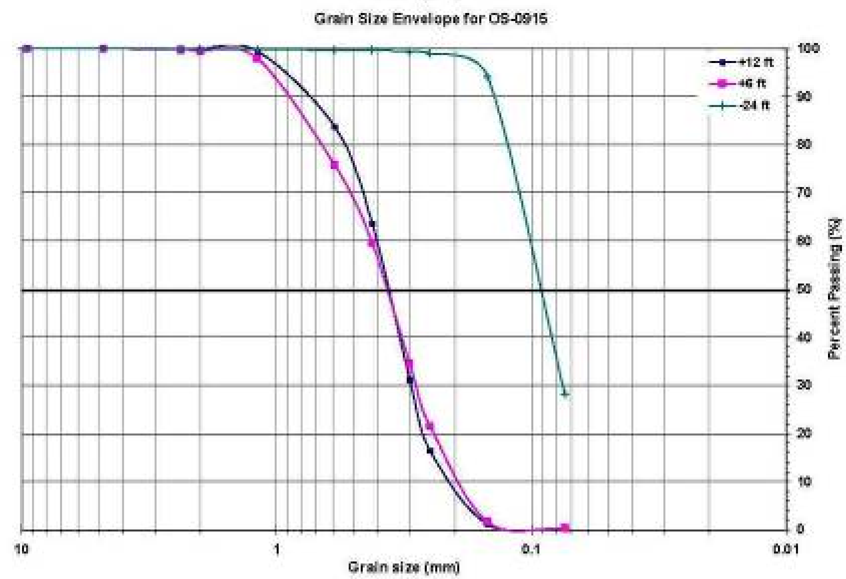
APPENDIX C

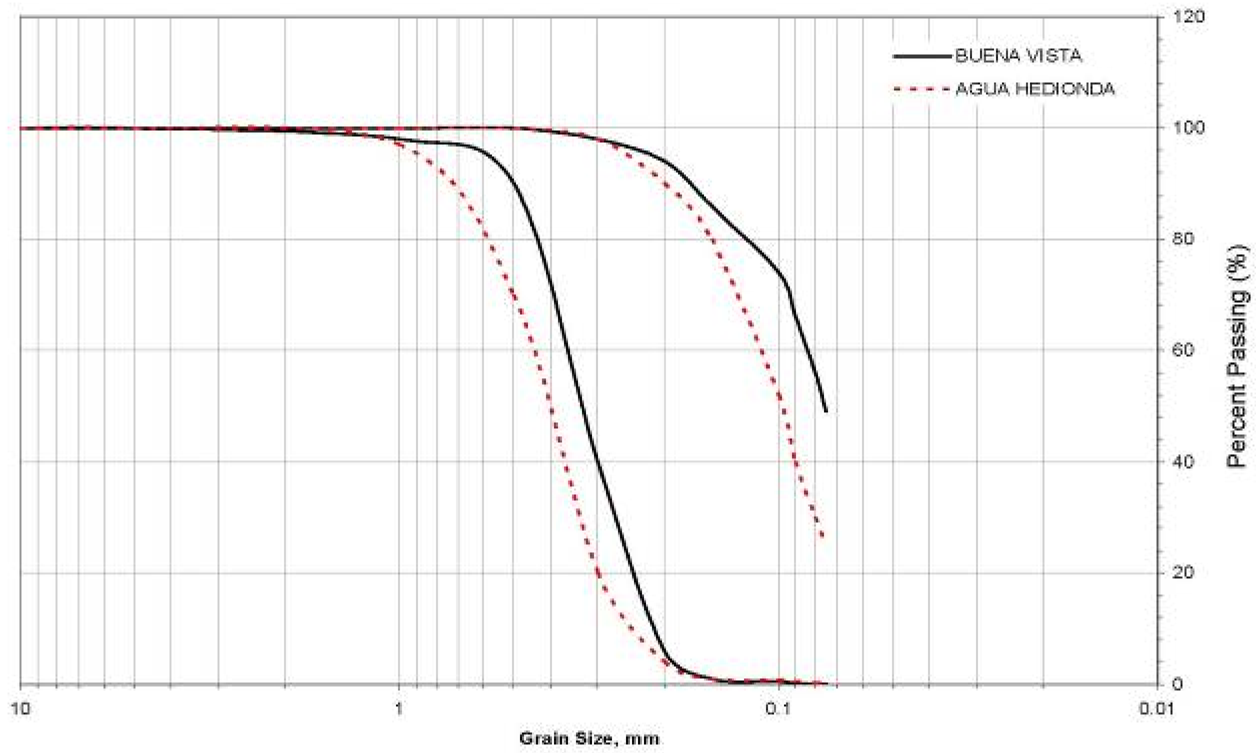
SAND GRADATION CURVES FOR SAN DIEGO REGION BEACHES

Existing Sand Gradation Curves for South Oceanside

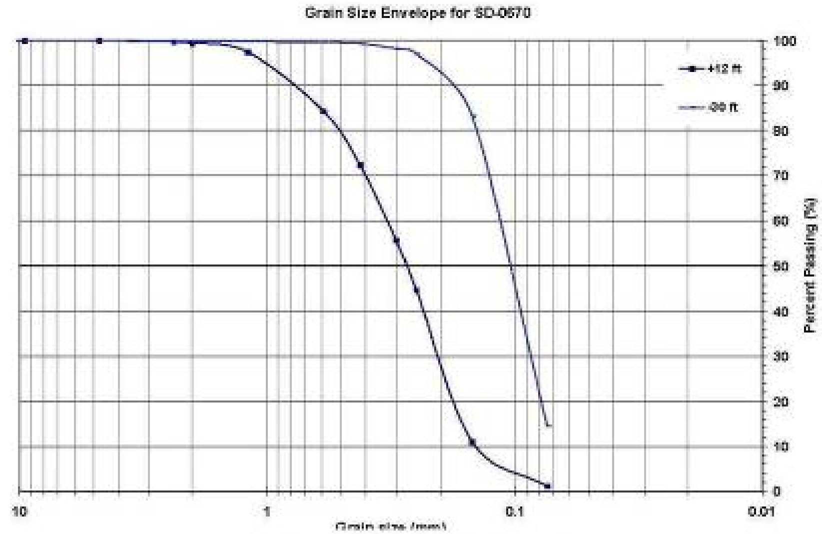


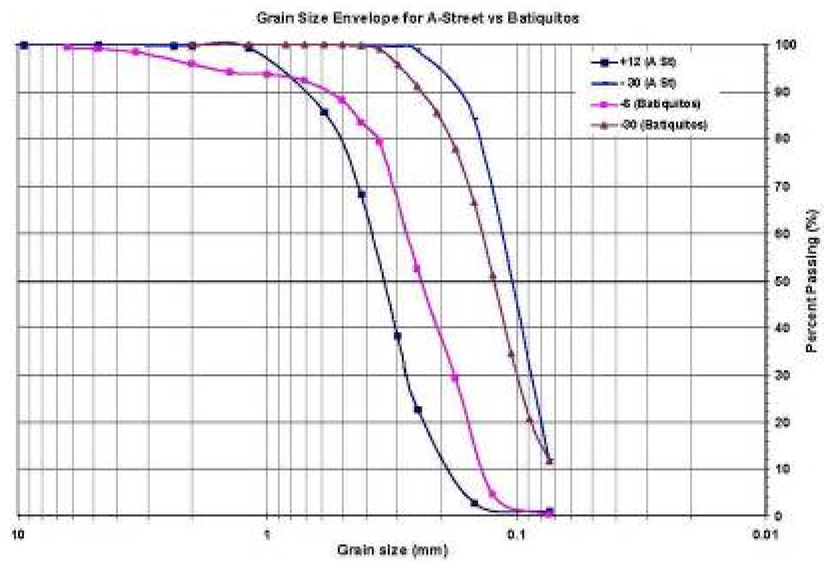


Existing Sand Gradation Curves for Carlsbad

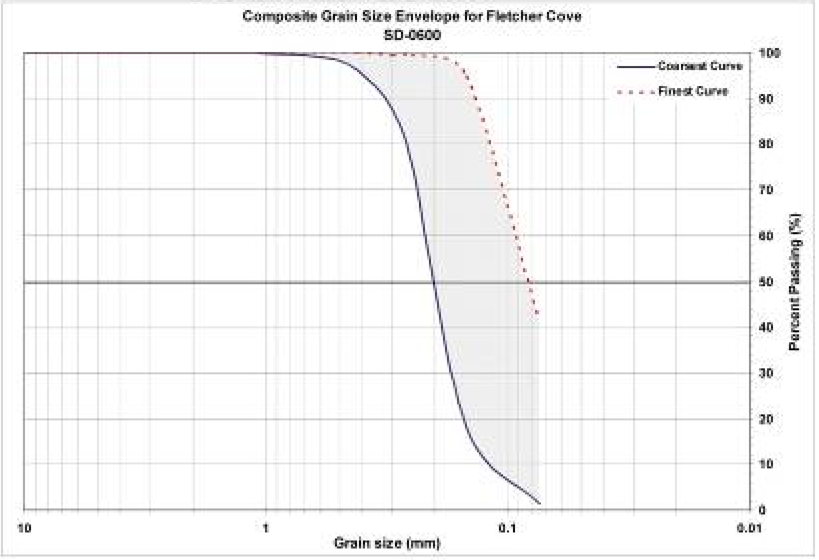


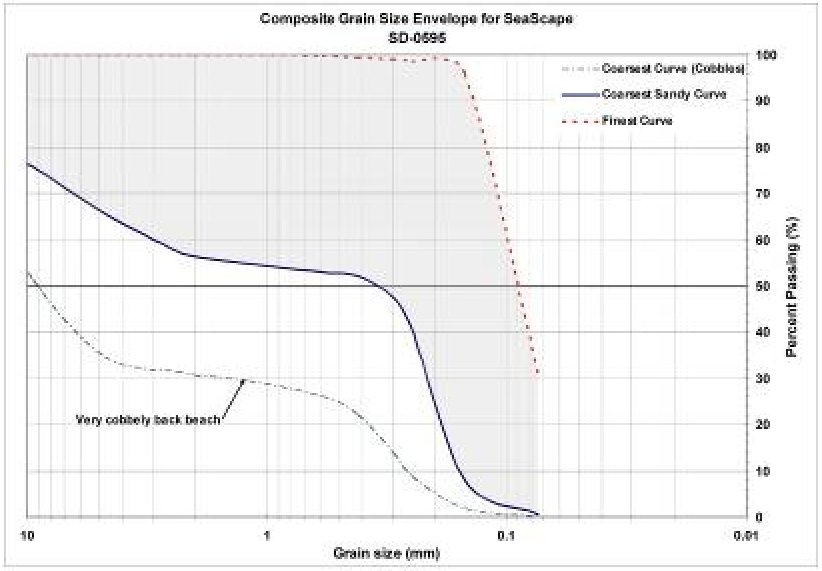
Existing Sand Gradation Curves for Encinitas



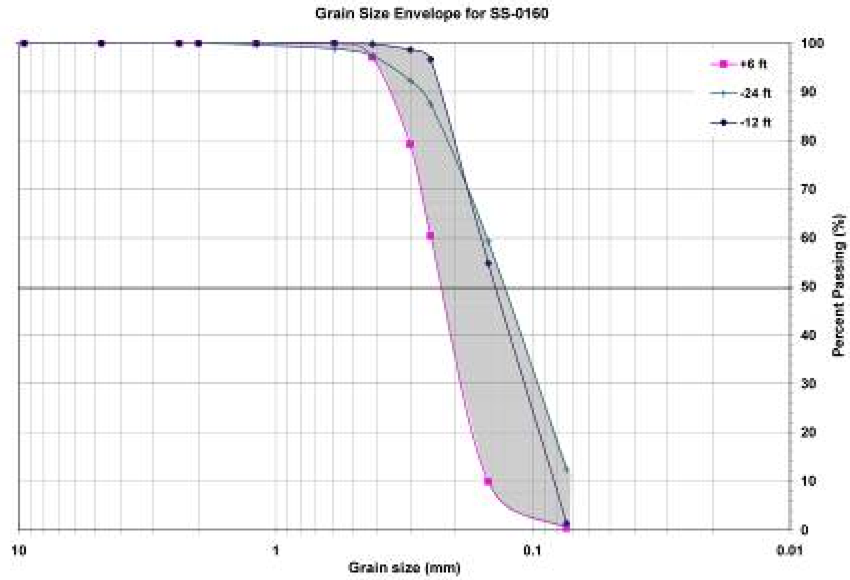


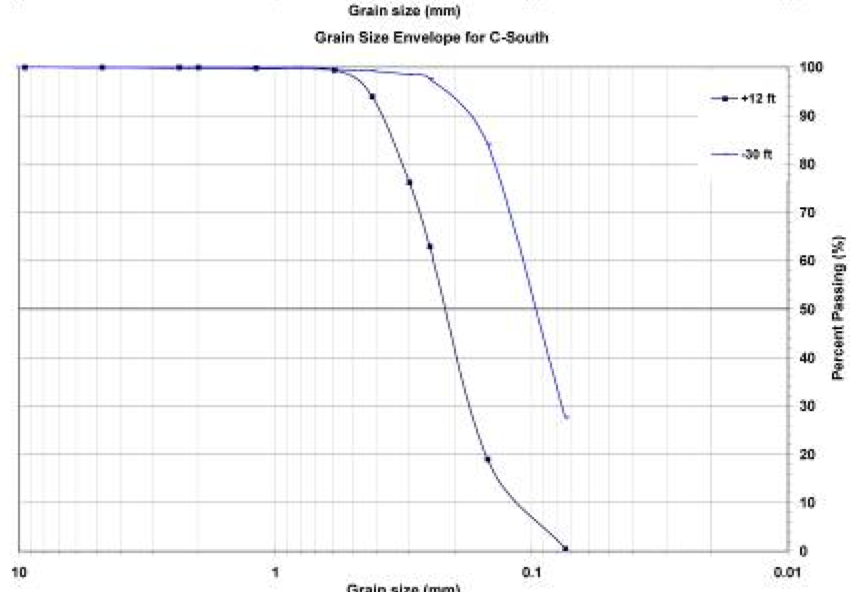
Existing Sand Gradation Curves for Solana Beach



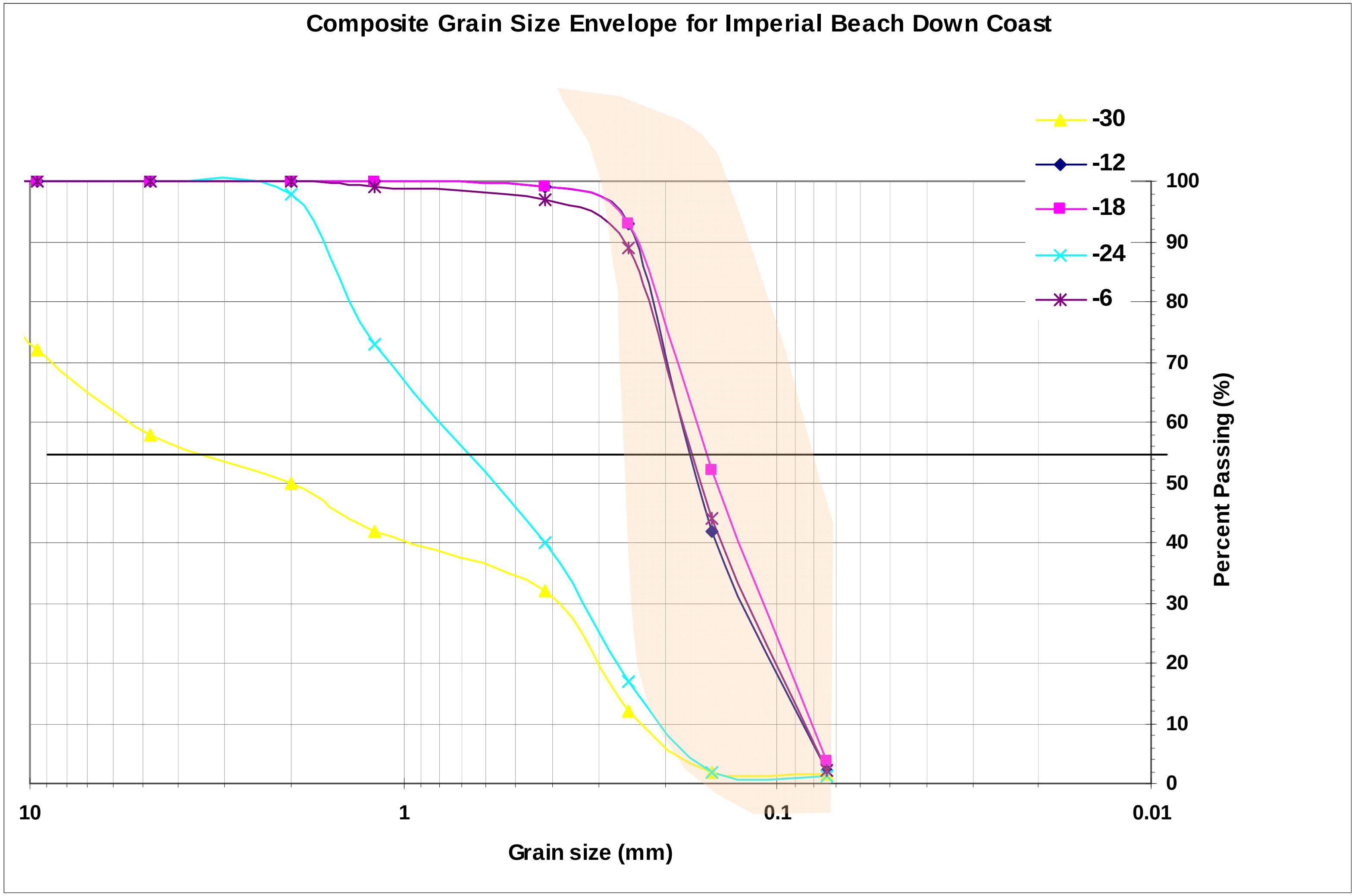


Existing Sand Gradation Curves for Coronado

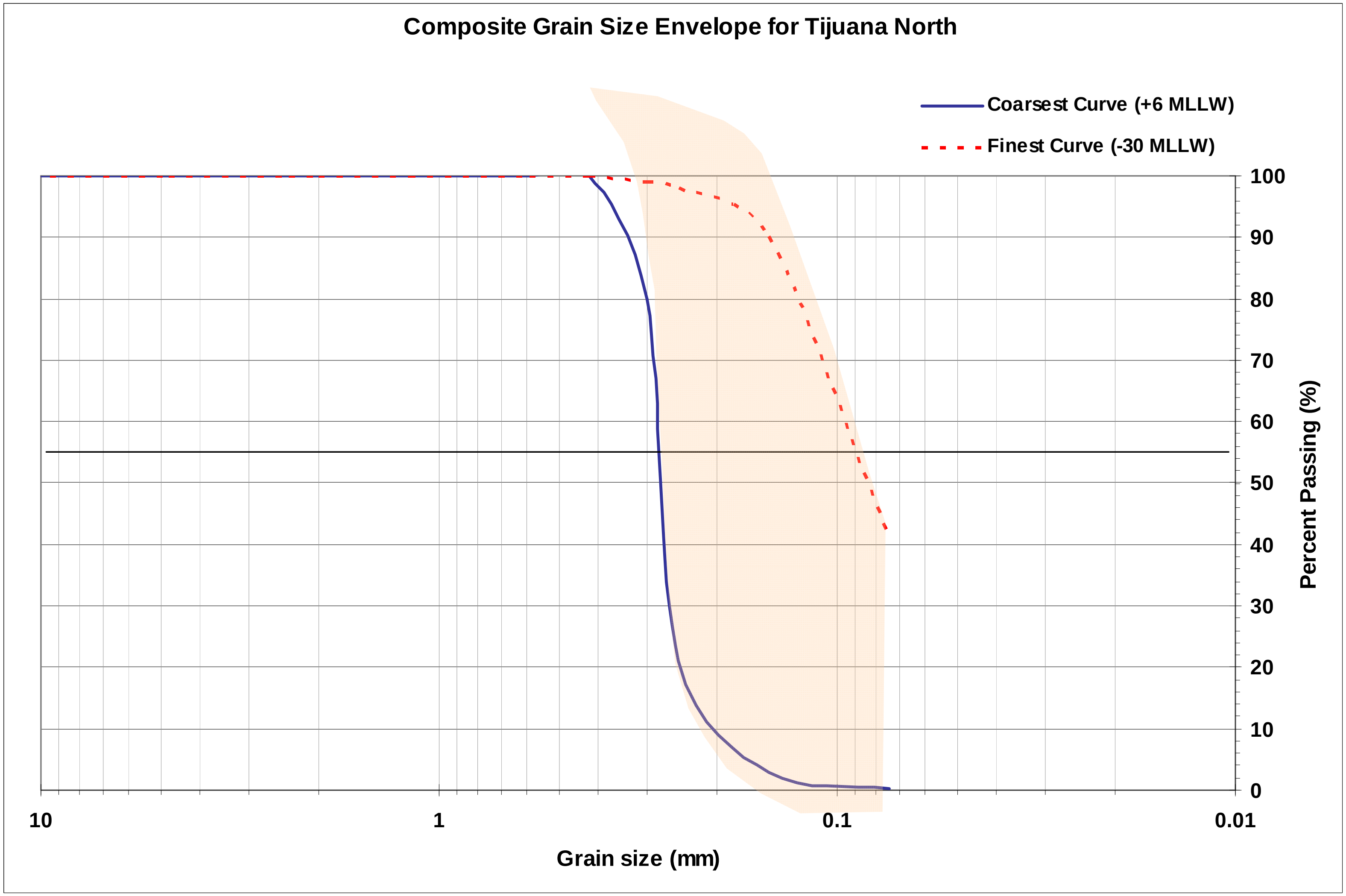




Existing Sand Gradation Curves for Imperial Beach



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 retention, 1 M CY/YR, terrestrial (0% fines) and offshore sand	$37,020,026	1,000,000	$18,740,321	0.5
Alternative 1 - No retention, 1 M CY/YR, terrestrial (25% fines) and offshore sand	$30,455,257	1,000,000	$18,740,321	0.6
Alternative 2 - No retention, 1 M CY/YR, offshore sand	$18,211,709	1,000,000	$18,740,321	1.0
Alternative 3 - Retention, 500 K CY/YR, terrestrial sand	$25,968,700	500,000	$18,740,321	0.7
Alternative 4 - Retention, 500 K CY/YR, offshore sand	$15,707,571	500,000	$18,740,321	1.2

Notes/Assumptions:
Costs in 2009$.
Costs include: construction, construction management, engineering, environmental review, contingency, monitoring, and maintenance.
Interest equals inflation = 5%.
50 year project lifetime.
Retention structures are pre-filled and maintained at year 25.
No retention beach benefit/volume ratio ($/CY) is derived from SANDAG and Moffatt & Nichol (2007) and indexed to 2009$. 18.74
Benefit/volume ratio ($/CY) with retention is twice the no retention value due to an assumed doubling of efficiency. 37.48
Benefits include recreation benefits and protection of public property from storm damage.
K=thousand, CY=cubic yards, YR=year, B/C=benefit to cost ratio.

ENGINEERS COST ESTIMATE

ALTERNATIVE 1 - NO RETENTION, 1 MCY/YR OF A COMBINATION OF TERRESTRIAL AND OFFSHORE SAND

	0% Fines in Terrestrial				
ITEM NO.	**ITEM DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT COST**	**SUBTOTAL**
	Average Annual Nourishment	1,000,000			
	Annual Terrestrial 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 Terrestrial				
ITEM NO.	**ITEM DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT COST**	**SUBTOTAL**
	Average Annual Nourishment	1,000,000			
	Annual Terrestrial 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**

<u>Assumptions</u>

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 $2009.
Terrestrial unit costs and Mob & demob cost based on M&N Sta. River to S. Clemente Beach
Monitoring Cost from SANDAG 2008 Annual Retreat, Session F, January 31, 2008, indexed to 2009$.
LS=lump sum, CY=cubic yard, YR=year, PROJ=project

12/15/2008

ENGINEERS COST ESTIMATE

ALTERNATIVE 2 - NO RETENTION, 1 MCY/YR OF OFFSHORE SAND

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

12/15/2008

ENGINEERS COST ESTIMATE
ALTERNATIVE 3 - RETENTION, 500 KCY/YR OF ALL TERRESTRIAL SAND

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Sand Retention Structures				
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 Terrestrial 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%
Terrestrial unit costs and Mob & demob cost based on M&N Sta. River to S. Clemente Beach
Retention structures are pre-filled. Costs from Moffatt & Nichol (2001). indexed to $2009.
Retention structure maintenance @ year 25 included.
Monitoring Cost from SANDAG 2008 Annual Retreat, Session F, January 31, 2008, indexed to 2009$.
LS=lump sum, CY=cubic yard, YR=year

12/15/2008

ENGINEERS COST ESTIMATE
ALTERNATIVE 4 - RETENTION, 500 KCY/YR OF ALL OFFSHORE SAND

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Sand Retention Structures				
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$.
Retention structures are pre-filled. Costs from Moffatt & Nichol (2001). indexed to 2009$.
Retention structure 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

12/15/2008

APPENDIX E

COASTAL MARINE HABITAT DATA

Table D-1. Sensitive Biological Resources 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 on-beach	> 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 on-beach	Offshore	Offshore	Offshore	NA	> 1,000 ft	> 2 miles	> 2 miles	> 2 miles	> 2 miles
Aqua Hedionda on-beach	660 ft upcoast	North & South ends	North & South ends	Rocks offshore	<200 ft	> 2 miles	> 2 miles	> 2 miles	> 2 miles
South Carlsbad on-beach	Offshore	Localized	Localized	Rocks offshore	> 1 mile	> 2 miles	> 2 miles	> 2 miles	> 2 miles
Batiquitos Beach on-beach	Offshore	Offshore	Offshore	NA	>1,500 ft	>900 ft	Adjacent	>800 ft	Adjacent
Batiquitos Nearshore	> 1,000 ft	> 1,000 ft	> 500 ft	NA	> 700 ft	> 1,000	> 600 ft	> 1,000	> 500 ft
Moonlight Beach on-beach	> 700 ft	>700 ft	> 900 ft	Rocks Offshore	> 2 miles	> 2 miles	> 2 miles	> 2 miles	> 2 miles
Cardiff on-beach	> 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	Outfall	> 1,500 ft	> 1 mile	> 2 miles	> 1 mile	> 400 ft
Fletcher Cove on-beach	> 300 ft	> 300 ft	> 800 ft	Localized rock offshore	> 1 mile	> 1 mile	> 2 miles	> 1 mile	> 1,900 ft
San Dieguito Lagoon on-beach	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
Del Mar on-beach	Offshore	Offshore	Offshore	NA	> 600 ft	> 2 miles	> 2 miles	> 2 miles	Within
Torrey Pines on-beach	Offshore	> 800 ft	> 1,900 ft	Cobble offshore	> 800 ft	> 2 miles	> 250 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 D-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 on-beach	> 1 mile	> 1 mile	> 1 mile	NA	> 1 mile	> 4,000	> 2 miles	> 4,000	Within
Mission Beach Nearshore	> 4,000 ft	> 4,000 ft	> 4,000 ft	NA	> 1 mile	> 3,800	> 2 miles	> 3,800	> 300 ft
Ocean Beach on-beach	> 1 mile	> 300 ft	> 2,600 ft	Rocks Offshore, > 1,300 ft from pier	> 1,500 ft	> 1,300 ft	> 2 miles	> 3,000	Within
Coronado Beach on-beach	> 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 on-beach	> 2 miles	> 1,000 ft	> 2,500 ft	> 900 ft from pier	> 2 miles	> 900 ft	> 300 ft	> 2,500 ft	Adjacent
Imperial Beach Nearshore (North)	> 2 miles	> 300 ft	> 300 ft	> 900 ft from pier	> 2 miles	> 1 mile	> 1 mile	> 600 ft	> 600 ft
Imperial Beach Nearshore (South)	> 2 miles	> 900 ft	> 600 ft	> 300 ft from pier	> 2 miles	> 3,900 ft	>2,900 ft	> 3,000 ft	> 2,900 ft
Tijuana Estuary on-beach	> 2 miles	> 3,000 ft	> 3,000 ft	> 3,000 ft	> 1,300 ft	Adjacent	Within	Adjacent	Within

Note: Maximum distances were reported as > 2 miles
* = New site