

# **CALIFORNIA BEACH RESTORATION STUDY**

**Department of Boating and Waterways and State Coastal Conservancy**

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Sacramento, California

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*cover photos provided by Coastal Frontiers Corporation*

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## **EXECUTIVE SUMMARY**

- ☛ *Visitors to California beaches spent over \$61 billion in 2001, of which approximately 36% was spent by out-of-state visitors. California's beaches generate over \$15 billion annually in tax revenue.*
- ☛ *To protect and restore this economic resource, the Department of Boating and Waterways has estimated that the State of California needs to invest \$120 million in one-time beach nourishment costs and \$27 million in annual beach maintenance costs. Through cost-sharing partnerships with the U.S. Army Corps of Engineers, federal funding for these shoreline projects could reduce the state's burden to \$42 million (65% reduction) and \$13.5 million (50% reduction) for restoration and maintenance costs, respectively.*
- ☛ *70-90% of beach sand is estimated to be delivered to California's beaches by rivers, but coastal dams prevent over one quarter of the average annual volume of sand supplied by streams from reaching the beaches. Removing dams or bypassing sediment around dams could significantly reduce the sediment deficit along much of California's coastline.*

The Public Beach Restoration Program (Program), created in 1999 by Assembly Bill 64 (Public Beach Restoration Act; Harbors and Navigation Code, sections 69.5-69.9), provided \$10 million for grants to be administered by the California Department of Boating and Waterways (DBW) in fiscal year 2000-01. This appropriation was substantially higher than the annual funding for beach-related projects in prior years.

A motivating factor behind the creation of the Program was the continued loss of public beaches due to intense coastal and inland development during the past century. Dams and other flood control measures have decreased the natural sediment supply to the coast, while jetties and breakwaters have blocked alongshore sand movement. A series of beach erosion problems, on both local and regional scales, have been exacerbated by these activities; in some cases, sand bypassing programs have been implemented to alleviate downdrift erosion.

Beach nourishment, or replenishment, is the introduction of sand onto a beach to supplement a diminished supply of natural sediment, for the purpose of beach restoration, enhancement or maintenance. Continued loss of many public beaches could be reduced substantially by beach nourishment. Limited capacity at already-narrow beaches, such as those in north San Diego County, will be further strained to meet growing demands for coastal access and recreation. Beaches made wide by past nourishment programs have begun to retreat and will continue to do so without replenishment. Narrowing beaches will lead to diminished recreational opportunities

and coastal access, degraded wildlife habitats, lost tourism revenues, and increased damage from coastal storms. The Program provides a funding vehicle to support restoration, enhancement, and maintenance of this valued resource.

A key component of the Program is the promotion of both local and federal partnerships. On the local level, the DBW has partnered with regional management agencies such as SANDAG (San Diego Association of Governments) and BEACON (Beach Erosion Authority for Clean Oceans and Nourishment). Federal partnerships have been forged with the U.S. Army Corps of Engineers (Corps). The DBW is currently involved in a number of federally-sponsored shoreline projects, and is actively pursuing additional partnership opportunities with the Corps. Cost-sharing agreements with the federal government make these partnerships particularly advantageous. Currently, 65% of the cost of the initial construction phase of a project is paid by the federal government, while 35% of the cost is covered by the non-federal partners, such as the state and a local government. For subsequent maintenance phases, costs are shared on a 50/50 basis.

In addition to authorizing funds for beach nourishment projects and research, the California Public Beach Restoration Act mandates that the DBW and the State Coastal Conservancy conduct a California Beach Restoration Study. This document reports the results of that study, the primary objectives of which are:

1. Detail the activities undertaken through the Program.
2. Assess the need for continued beach nourishment projects.
3. Evaluate the effectiveness of the program in addressing that need.
4. Discuss ways to increase the natural sediment supply in order to decrease the need to nourish the state's beaches.

### **Activities Undertaken through the Program**

Following a review of grant applications submitted by various local agencies for the 2000-2001 funding cycle, \$10 million was allocated for 16 beach-related projects. These projects range from local and regional beach nourishment programs to coastal research. The majority of the program budget was used for beach nourishment projects, several of which were cost-shared with the Corps. The remaining funds in that funding cycle were used for additional studies and research into erosion control and California coastal processes (Figure A).

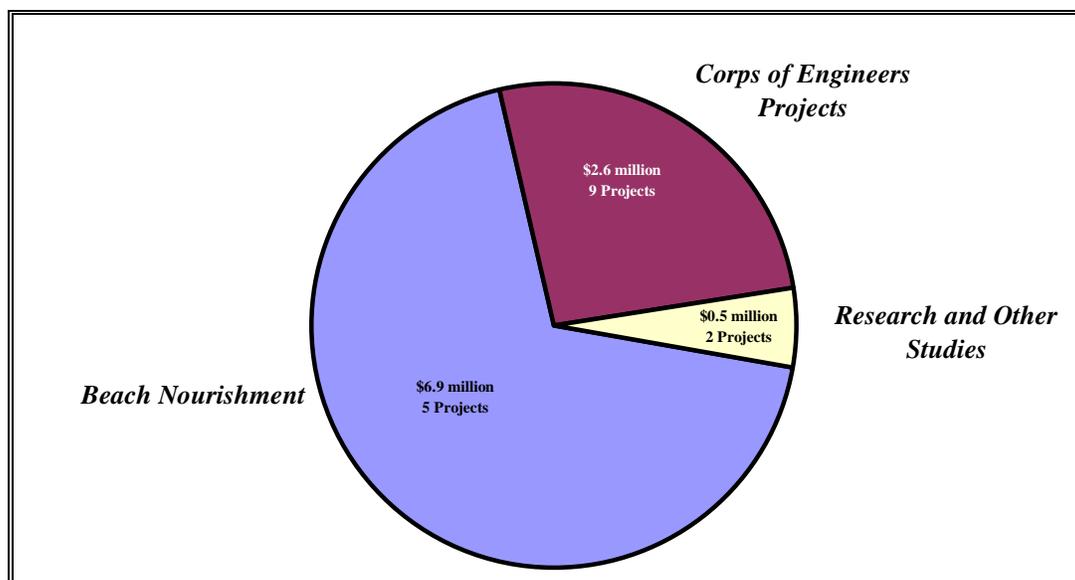


Figure A. Allocation of Public Beach Restoration Program Funds (FY 2000-01)

### **Need for Continued Funding of the Public Beach Restoration Program**

After a century of intense development, the California shoreline is largely influenced by human activity. Alterations of the natural system have resulted from the damming of rivers, flood control, sand nourishment, and sediment-blocking structures. This is particularly true in southern California. Effective resource management is necessary to minimize beach erosion, maintain existing recreational beaches, and provide storm protection for public development.

The DBW has estimated that the State of California needs to invest \$120 million in one-time beach restoration costs and \$27 million in annual beach maintenance costs for 23 projects in 8 coastal counties. These projects would directly replenish 24 miles of heavily-used public beaches and collaterally benefit more than twice that length due to alongshore sand transport. Through cost-sharing partnerships with the U.S. Army Corps of Engineers, federal funding for these shoreline projects could reduce the state's costs to \$42 million (65% reduction) and \$13.5 million (50% reduction) for restoration and maintenance, respectively.

California beaches provide numerous benefits to the state and its residents. Some of these benefits are:

- **Recreational Opportunities:** Over two-thirds of Californians visit the beach each year. California's beaches experienced an estimated 659 million visitor-days in 2001, more than twice as many as the visitor-days at all U.S. National Parks combined. Of the state's top ten recreational destinations in 1991, three were beaches.

- **Sustainable Tourism:** Tourism is California's third-largest industry, and beaches attract many visitors to the state.

*Spending on Beach Trips:* Visitors to California beaches spent over \$61 billion in 2001; approximately 36% of this total was spent by out-of-state visitors.

*Tax Revenues:* California's beaches generate over \$15 billion annually in tax revenue (excluding social insurance). Table A provides estimates for local, state, and federal tax revenue.

**Table A. Estimated Taxes Derived from Beach Spending**

Government	Estimated Tax Generated	Percentage of Total Taxes Generated
Federal	\$8.1 billion	53.4%
California State	\$4.6 billion	30.5%
County	\$1.2 billion	8.1%
City	\$1.2 billion	8.1%
<b>Total</b>	<b>\$15.2 billion</b>	<b>100.0%</b>

- **Coastal Access:** Nourishment can improve access to public shorelines, which are often difficult or dangerous to reach when beaches are narrow.
- **Public Health and Safety:** Beach nourishment provides numerous public health and safety benefits to residents and visitors. Wider beaches can reduce the number of sudden and dangerous bluff collapses. Increased beach widths allow public safety personnel access to respond more effectively to emergencies.
- **Wildlife Habitat:** Maintaining sandy beaches will provide habitat for many species, including several listed as threatened or endangered.
- **Protection of Public Property:** Beaches are a natural form of coastal protection; beach nourishment can reduce the need for hard structures such as revetments.

### **Effectiveness of the Program**

Nourishment projects funded through the Public Beach Restoration Program are in the early stages of implementation, making an evaluation of their effectiveness premature. Judging from the success of prior nourishment projects, however, the current projects offer the potential for significant improvement of the state's coast.

Beach nourishment has been conducted in California for most of the past century. Many of California's most renowned beaches were created and are maintained by nourishment programs. Beaches such as Santa Monica, Venice, Newport and Mission Bay were narrow under natural conditions and incapable of supporting present-day demands for coastal access and recreation.

These beaches are now major tourist attractions, providing substantial economic and recreational benefits.

Representative historical beach nourishment efforts conducted in California include:

- **Planned Regional Beach Nourishment in Orange County:** Scheduled periodic nourishment at Surfside-Sunset Beach and nourishment with sand retention devices at Newport Beach have led to the placement of nearly 18 million cubic yards of sand on the beaches between Anaheim Bay and Newport Harbor since 1963. Results from the recent *Coast of California Storm and Tidal Waves Study – Orange County Region* indicate that the majority of this material has remained in the local sediment system (littoral cell), and beach widths in the region have increased at an average rate exceeding 4 feet per year.
- **Opportunistic Nourishment in Santa Monica Bay:** Since the 1930's, over 31 million cubic yards of sand have been placed on the Santa Monica Bay beaches, most of which (over 90%) became available from construction and dredging activities. The cumulative effect of these independent projects was the creation of wide, sandy beaches in an area that was once characterized by naturally narrow beaches.

### **Increasing Natural Sediment Supply**

While beach nourishment is one way to increase the volume of sand on California's beaches, it is important also to consider increasing the natural supply of sediment to the shoreline. The primary source of natural sediment supply to beaches is discharge from rivers and streams. Bluff erosion is also a source of beach sand along much of the coast. Human activities have significantly affected both of these sand sources through the construction of dams, debris basins, hard channelization of stream beds, and seawalls and revetments along coastal bluffs.

In order to discuss ways to increase natural sediment supply to the coast, it is necessary to quantify the sediment volumes provided through each supply process and to assess the impact of human activities on this system.

### **Fluvial Sediment Supply and Reduction**

- Rivers are estimated to provide 70 to 90% of the beach-size material to the coast.
- Over 480 major dams (under the jurisdiction of the Department of Water Resources' Division of Safety of Dams) have been built in California's coastal watersheds (excluding areas draining to San Francisco Bay).

- Coastal dams, built primarily for water supply, irrigation, and flood control, impact 38% (over 16,000 mi<sup>2</sup>) of the state's coastal watershed area and impound 26% of the average annual beach-size sediment provided by streams.
- Southern California, from Point Conception to San Diego, is the region most highly affected by dams, with six of seven major littoral cells receiving two-thirds or less of the historical fluvial sediment supply.
- In Southern California each year, more than 1.5 million cubic yards of sand-size material are impounded behind dams and within debris basins. If sand were removed from behind just twelve dams, identified in this report, then the increase in local sand budgets would be substantial. If sand were bypassed around these dams at the same rate as long-term average sand deposition in the reservoirs, then bypassing could offset 40% of the sediment deficit in these Southern California littoral cells.
- In the Santa Barbara littoral cell, dam construction has reduced the volume of sediment added by streams by 41%; in the Oceanside littoral cell, dam construction has reduced the fluvial contribution by 54%.
- Long-term beach loss can be expected without management of sediment in fluvial systems.

### **Bluff Sediment Supply and Reduction**

- The great majority of the coast of California consists of actively eroding sea cliffs. Specifically, 13% of the coastline is high-relief, steep mountains that contribute a negligible amount of sand to the littoral budget, and 59% of the coastline is low-relief (less than 300 ft) wave-cut bluffs or terraces that, when eroded, will produce a greater percent of sand-sized material than the high-relief, mountainous shoreline.
- Approximately 102 miles of the state's coastline (10%) are presently armored; 58 miles (57%) of this armor lines coastal lowlands and dunes while the remaining 44 miles (43%) of armor protect sea cliffs.
- Results of an analysis of sediment contributions from bluff erosion in two different coastal areas highlight the importance of considering solutions to beach erosion on a regional, rather than statewide, basis. In the Oceanside littoral cell, cliff and bluff erosion historically contributed 11% of the littoral budget. Armoring the cliffs of the cell has reduced the sand contribution by 18%. In contrast, bluff erosion historically contributed only 0.4% of the natural sediment budget in the Santa Barbara littoral cell; in this cell, efforts to increase natural sediment supply should focus on fluvial sediment sources rather than bluff erosion.

## **Recommendations**

- ***Continue Investing in Beaches:*** Past beach nourishment experience in California has shown that continued funding for sand is justified by the economic benefits from tourism and beach recreation associated with wide sandy beaches (including \$4.6 billion in tax revenue for the state). California should continue funding the Public Beach Restoration Program and invest in opportunistic beach replenishment.
- ***Plan Regionally:*** The California coastal environment is diverse. As a result, beach nourishment and sediment supply improvement concepts applied to one region may not be appropriate for another. Potential projects should be evaluated on a regional basis to identify the most effective solutions. The California Coastal Sediment Management Master Plan, funded through the Resources Agency, will be instrumental in enabling regional planning of sediment-related projects. As part of the Master Plan, many of the studies this report has identified as necessary to attain the goals of replenishing beaches and increasing natural sediment supply to the coast will be initiated. Identified studies include:
  - ***Analysis of Sediment Reduction:*** A detailed study should be performed of historic beach widths and volumes to determine the extent to which any systematic reduction in beach width has taken place, and if so, how this reduction relates spatially and temporally to the reduction in natural sediment supply.
  - ***Analysis of Environmental Impacts:*** Environmental limits on sediment removal from individual reservoirs and debris basins should be investigated; these explorations should include grain size analysis to assess the size distributions of impounded sediments, identification of sediment transport alternatives, and assessment of impacts to estuaries due to increased fluvial sediment loads.
  - ***Assessment of Impacts from Increasing Sediment Transport Rates:*** Fluvial systems are in quasi-equilibrium with existing sediment loads. To understand the implications of altering these loads, the geomorphological, sedimentological, and ecological impacts of increasing sand transport rates in coastal systems should be modeled.
  - ***Establishment of Data Collection Standards:*** Better records of the number of channelized streams, miles of channelization in streams, volumes of sediment extracted from stream channels and debris basins, and the grain size distribution of the extracted sediments should be kept by local government agencies to identify opportunistic sand sources.
- ***Remove or Bypass Dams:*** Substantial increases in sand volume to local sediment budgets, resulting in wider beaches, could be realized by removing those dams that are no longer

serving any useful function, and bypassing sediment around those that are functional but impound significant volumes of sand.

- **Promote Opportunistic Sand Nourishment:** At a number of sites, “sand of opportunity” has been utilized as beach nourishment material with great success. However, under current guidelines, the cost and complexity of regulatory compliance often precludes the use of opportunistic material from sources such as debris basins and wetlands. The regulatory process for beach nourishment with opportunistic sand should be simplified to the maximum extent possible without compromising environmental safeguards.
- **Monitor Projects:** Beach nourishment projects should be monitored to accomplish the following objectives:
  - Determine if the project meets design expectations;
  - Develop an appropriate maintenance schedule;
  - Assess environmental impacts; and
  - Quantify the economic benefits of the project.

An increased understanding of the performance of nourishment projects in California will lead to more effective solutions to beach erosion.

*Citations for data presented in this Executive Summary can be found in the text of the report.*