Title
Mitigation of Coastal Bluff Instability in San Diego County

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Mitigation of Coastal Bluff Instability in San Diego County

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Background

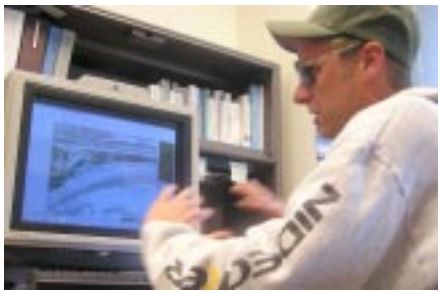
Coastal erosion poses serious problems in Southern California. It threatens homes, businesses, roads and railroad lines built close to the edge of cliffs. It is shrinking the size of popular beach parks and rare coastal wilderness areas.

Although some state parks have lined beaches with rip-rap, most are not engaging in efforts to protect coastal lands with hard structures. Private homeowners and businesses, however, are building sea walls, retaining walls, "soldier piles" and other structures as protection against waves, tides, rising sea level and surface runoff. The visual impacts of these structures draw criticism from some environmentally minded Californians and from businesses and coastal communities dependent on beach-related tourism.

Engineers also debate the consequences of hard structures. Critics say they exacerbate sand loss by deflecting wave energy and create a negative for communities that benefit from the economic and recreational value of sandy beaches.

Coastal erosion is a problem on both the U.S. East and West coasts, as well as in the Gulf of Mexico. The problem, however, is intensified in Southern California by the region's high seismic activity, its geology, and its dense coastal development. Erosion-control strategies offering relief in San Diego County will very likely be helpful to other communities on the West Coast with similar erosion problems and high population densities.

A typical warning sign posted along the San Diego County coastline. Photo: Scott Ashford, UCSD



Sea Grant Trainee Adam Young wears glasses that enable him to see an image of the California shoreline in 3D. Photo: Christina S. Johnson, California Sea Grant

Concrete wall at bluff base in Solana Beach. Inset shows detail of wall failure, also visible in center of photo. Photo: Scott Ashford, UCSD

Project

California Sea Grant is funding UC San Diego structural engineer Scott Ashford to develop recommendations on how to mitigate the hazards of coastal bluff instability in northern San Diego County. In particular, he is examining whether sea walls, retaining walls and other hard structures do indeed slow erosion and if so, by how much and at what cost. He is also testing a new environmentally friendly stabilization technique.

The first phase of the project involved estimating erosion rates for the community of Del Mar. To do this, UCSD graduate student Adam Young, a Sea Grant Trainee, scanned sets of aerial photos of the coastline collected over a 70-year period. The scans have been converted into a series of GIS-compatible maps, showing the rates of sea bluff retreat since1932. The maps are viewable as 3D topographic images. Young is in the process of mapping erosion rates for Solana Beach and Encinitas.

When completed, he will begin mapping the locations of hard structures in these areas and then will use the GIS maps to measure the pace of erosion (as measured by bluff retreat) since their construction. The idea is to identify the relative effectiveness of different stabiliza-

LIDAR scanning in process on a section of bluffs in Solana Beach.The laser emits infrared light and records its "echo." Photos this page: Christina S. Johnson, California Sea Grant

Structural engineer Scott Ashford.

tion methods, their relative costs and environmental impacts.

In 2003, engineers began taking a series of laser scans of sections of the coast, using a remote sensing technology known as LIDAR, an acronym of LIght Detection And Ranging. These high-resolution images can detect minute changes in the bluffs before and after winter. Beaches usually lose sand in winter, when storms from the north Pacific bring heavy surf.

LIDAR scanning may be able to monitor beach sand loss and gain on a seasonal time scale, offering communities a relatively inexpensive way to monitor the effectiveness of beach nourishment plans. It would also let scientists measure how much bluff material replenishes beaches annually.

Besides evaluating erosion and the effects of hard structures on the coast, the scientists have begun experimenting with the idea of injecting colloidal silica into loosely consolidated sea cliffs, as a way to cement sandstone materials firmly together. Colloidal silica has the viscosity of water and once injected into sandstone would fill spaces between grains, hardening into a stable material. Silica is natural, relatively inexpensive and would have no visual side effects.

Findings

The engineers' preliminary findings suggest that erosion rates in northern San Diego County are less than some previously thought. Based on their preliminary analyses, bluffs in Del Mar have been eroding at a rate of about 5 centimeters a year, though some areas are disappearing at a rate of 30 centimeters annually. Some areas with slower rates of erosion, they believe, may be "hot spots" at greater risk of episodic events in the future.

The findings will be presented in a manual for city and state officials, the North County Transit District, U.S. Army Corps of Engineers, California Coastal Commission, land planners and other parties interested in alternative methods for stabilizing sea cliffs. The engineers will also post their results on the web for public downloading.

Collaborating Organizations

California Coastal Commission
City of Del Mar
City of Encinitas
City of Solana Beach
North County Transit District
U.S. Army Corps of Engineers

Trainee

Adam Young

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