Nourishment of the Beach in Galveston, Texas

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In 1995, Galveston, Texas, completed the nourishment of a portion of its eroded beach. The purpose of the project was not for storm protection, but to provide a recreational beach for island residents and in support of tourism on Galveston Island.

Galveston had initially identified a sand borrow source to be used to construct the beach nourishment project. The borrow area identified by the City was the sub- merged portion of the "Big Reef' shoal in the Galveston Harbor ship channel. The City commissioned a bathymetric survey to define the underwater depth contours of the shoal, and vibracores were taken by Texas A&M University to evaluate the sand characteristics of the shoal and assess its compatibility with the native beach material. On the basis of these studies of Big Reef shoal, Galveston computed an approximate volume of sand within the borrow area of about 950,000 cubic yards. In 1993 the City retained the services of Coastal Planning and Engineering, Inc. (CPE) of Boca Raton, Florida, to provide coastal engineering design and permit acquisition services. It became apparent to the CPE engineers that the Big Reef sand source was marginal. The engineers were concerned that the cost to dredge the sand onto the eroded beach could exceed the budget for project construction. One reason was that the distance from the borrow source to the beach nourishment site, in conjunction with potential dredging losses of the fine material, would reduce dredging efficiency. The anticipated lower dredging efficiency, in turn, could result in construction bids exceeding the City's budget for the project. A second concern was a hardpan layer within the potential sand source. Dredge contractors were apprehensive that the layer could be problematic for dredging. Bids received by the City for project construction verified the two concerns, as each of the bids significantly exceeded the project budget.

In anticipation of bids exceeding the project budget for use of the Big Reef borrow source, the engineers at CPE researched available offshore geophysical information to determine if a suitable sand source could be found closer to the beach nourishment spoil area. Of specific interest were sediments seaward of the project site in the Gulf of Mexico. Other potential sources of material were researched but dismissed because of concerns related to suitability, economics, or environment. Bay sand deposits were rejected because of the probable presence of silt or mud, possible environmental contaminants, and other environmental considerations related to dredging in estuaries. Potential sand sources were also available in San Luis and Rollover Passes, but they were located too far from the project area beach to be economical for use. U.S. Army Corps of Engineers sand-search information for the Gulf of Mexico indicated that the sediments seaward of the project area held some potential. Although records indicated that the Gulf bottom was comprised mainly of silty or muddy sediments, possible deposits of find sand were also indicated. It was apparent that a detailed sand search would be required in an attempt to locate sand sources with sufficient volume and layer depth to provide an economical borrow area.

After CPE developed an initial vibracoring plan based on the analysis of available geophysical information, vibracoring operations commenced in May 1994. CPE utilized personnel and equipment from Rice University to conduct the vibracoring operations. Each day after the completion of vibracoring operations, the cores were split and examined by the CPE sand-search project manager. The quality of the material in each core was visually assessed. After evaluating and charting each vibracore, and consulting with CPE coastal engineers in Boca Raton, the vibracoring plan was modified to refine the search pattern for the next day. Vibracore sites were added to the original sand-search plan, and other sites were eliminated if it appeared that the potential for locating compatible sand was minimal. Through

continued, ongoing refinement of the sand-search pattern, three potential borrow areas were identified.

The potential borrow areas were also investigated for the presence of cultural resources through a remote sensing survey conducted by Coastal Environments, Inc. of Baton Rouge, Louisiana. The investigation included a magnetometer survey and a side-scan sonar survey. Magnetic anomalies were detected in two of the potential borrow areas. On the basis of the magnetic anomaly patterns and strengths, and of historical research, the anomalies in the two borrow areas were presumed to be telegraph cables placed in the late 1800s and early 1900s by the Mexican Telegraph Company. No magnetic anomalies were detected in the third potential borrow area.

It was determined that all three borrow areas would be made available for construction bidding purposes. Borrow Areas "B" and "C," which contained the telegraph cables, were closer to the project area, but consisted of a narrow sand layer, which would reduce dredging efficiency. These two borrow areas were partitioned by the cables, which would have to be avoided by the dredging activity. Borrow Area "A" provided a deeper sand layer for dredging and contained no magnetic anomalies. Nevertheless, Borrow Area A was farther from the project site than either Area B or C. Because no borrow area provided a significant advantage, all three were available to the contractors bidding on the project.

The beach nourishment project was designed to be constructed within the groin field fronting the City of Galveston beach. A design profile was developed based on the existing (equilibrium) beach profiles east of the project area. Historical profiles were used to develop the typical design profile, which included a 1-ft vertical to 40-ft horizontal slope. Two high-erosion areas predicted by the computer modeling indicated the need for additional sand. The high-erosion areas include the two eastern groin compartments and the beach at 51st. Street, near the west end of the project. Fill configurations were developed for the project to accommodate the predicted high-erosion areas. The four most promising fill configurations were modeled to determine the best beach fill option. The selected plan predicted that a minimum beach width of 50 ft would remain at the two high-erosion areas (i.e." areas of accelerated erosion) after the 7-year life of the project. The project called for an approximate volume of 710,000 cubic yards of sand to be placed along the 3.6-mile project area.

With the availability of the three new potential borrow areas, the project was bid and a dredge contractor was selected. The winning bid was more than $2.5 million lower than the lowest bid obtained for the use of the Big Reef borrow area. Thus, significant project cost savings were achieved through identification of a more economic sand source. The low bid was awarded based on use of Borrow Area A, which contained the deeper sand layer and no magnetic anomalies. On December 23, 1994, a dredge was towed into the borrow area and began pumping sand onto the beach the next day. Although a number of periods of bad weather delayed project construction, fill placement was completed in late May 1995, in time for the 1995 summer tourist season. Island residents and tourists alike were able to enjoy the newly nourished beach in an area where the beach had previously been eroded.

References

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