FEASIBILITY REPORT

SHORELINE EROSION ASSESSMENT AND PLAN FOR BEACH RESTORATION

BRIDGEHAMPTON–WATER MILL BEACH, NEW YORK

Prepared for:

Bridgehampton–Water Mill Erosion Control District
Town of Southampton New York

FEASIBILITY REPORT

Shoreline Erosion Assessment and Plan for Beach Restoration Bridgehampton–Water Mill, New York

Prepared for:

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[2369-01-FR]
February 2012

COVER PHOTO: Mecox Beach on 7 December 2011 showing erosional escarpment in the foredune. [Photo by A Terchunian, First Coastal Corporation]

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SYNOPSIS

The team of First Coastal Corporation and Coastal Science & Engineering Inc (CSE) was retained by the Bridgehampton–Water Mill Erosion Control District (ECD) to evaluate shoreline erosion along the ~3.0-mile ocean beach within the village limits and develop alternate plans for beach restoration (Fig A). The goal of the project is to improve the beach-dune system via additions of sand from an external source so that:

- Recreational opportunities are enhanced via a wider beach.
- The community tax base is preserved.
- Normal seasonal processes of erosion and accretion may occur without adverse impact to the dune system or development.
- The aesthetic quality and ecological values of the beach are maintained.
- Flooding in storms is reduced.

The target design life for the project is a minimum of ten years* consistent with a majority of locally sponsored beach restoration projects. Beach improvements at 5-year, 10-year, and 20-year levels are also evaluated in the present report.

*[*Design life is defined herein as a significant additional volume of sand remaining within the littoral zone of the project area after 10 years such that the overall condition of the beach dune system is better than preproject conditions.]*

FIGURE A. Vicinity map showing the Bridgehampton-Water Mill-Sagaponack project areas situated along the 30-miles strand beach between East Hampton and Shinnecock Inlet. Net sand transport is east to west along the south shore of Long Island.

The findings assume that a parallel project can be accomplished at the same time along the Sagaponack shoreline, thereby yielding economies of scale. The longevity of beach nourishment increases geometrically with project length. Combining the Bridgehampton-Water Mill project with the Sagaponack project will double the length and likely quadruple the project life (NRC 1995, Dean 2002).

The general approach of the team was to review historical data and related projects along the Southampton coast, conduct detailed condition surveys of Bridgehampton–Water Mill Beach, and determine the sand deficit and average annual erosion rates for two reaches. A recommended project was formulated based on analysis of the existing level of protection seaward of buildings, the relative condition of the beach and inshore zone from one reach to the other, and the controlling coastal processes and net sediment transport rates. The team reviewed potential offshore borrow areas designated by the US Army Corps of Engineers (USACE) and conducted additional field surveys for purposes of identifying other potential borrow areas.

Four feasible borrow areas were identified based on previous federal studies and results of new borings in depths around 50 feet (ft) of water. One of the areas is situated about 1 mile offshore of Sagaponack Pond at the eastern end of Bridgehampton Beach. The USACE has also designated three potential borrow areas (6F, 6G, and 6H) off Bridgehampton–Water Mill in close proximity to the beach. Preliminary geotechnical surveys by USACE and the present study indicate there is likely to be sufficient beach-quality sediment in the offshore area to accomplish a locally sponsored project (pending detailed confirmation of sediment quality and approval for use by the USACE and NYDEC).

KEY FINDINGS

Condition Survey, Sand Deficit, and Annual Erosion Rate

The team completed a detailed condition survey in July 2011 and confirmed the volumes of sand in the foredune, on the beach, and in the nearshore zone (Fig B). The survey demonstrated that differences in volume reflect positions and depths of the offshore bar with more sand indicating the bar is closer to shore, its crest is shallower, and the adjacent visible beach is wider. Bridgehampton–Water Mill Beach was found to have a sand deficit in the profile with less dune protection seaward of houses and pools. The eastern half (Reach 3) generally has narrower development setbacks and dune protection than the western half (Reach 4), although there is great variability in structure setbacks. Fully 20 percent of properties along the oceanfront have buildings, pools, or cabanas within <50 ft of the seaward vegetation line. Five properties (out of ~70) were positioned <20 ft from the vegetation line.

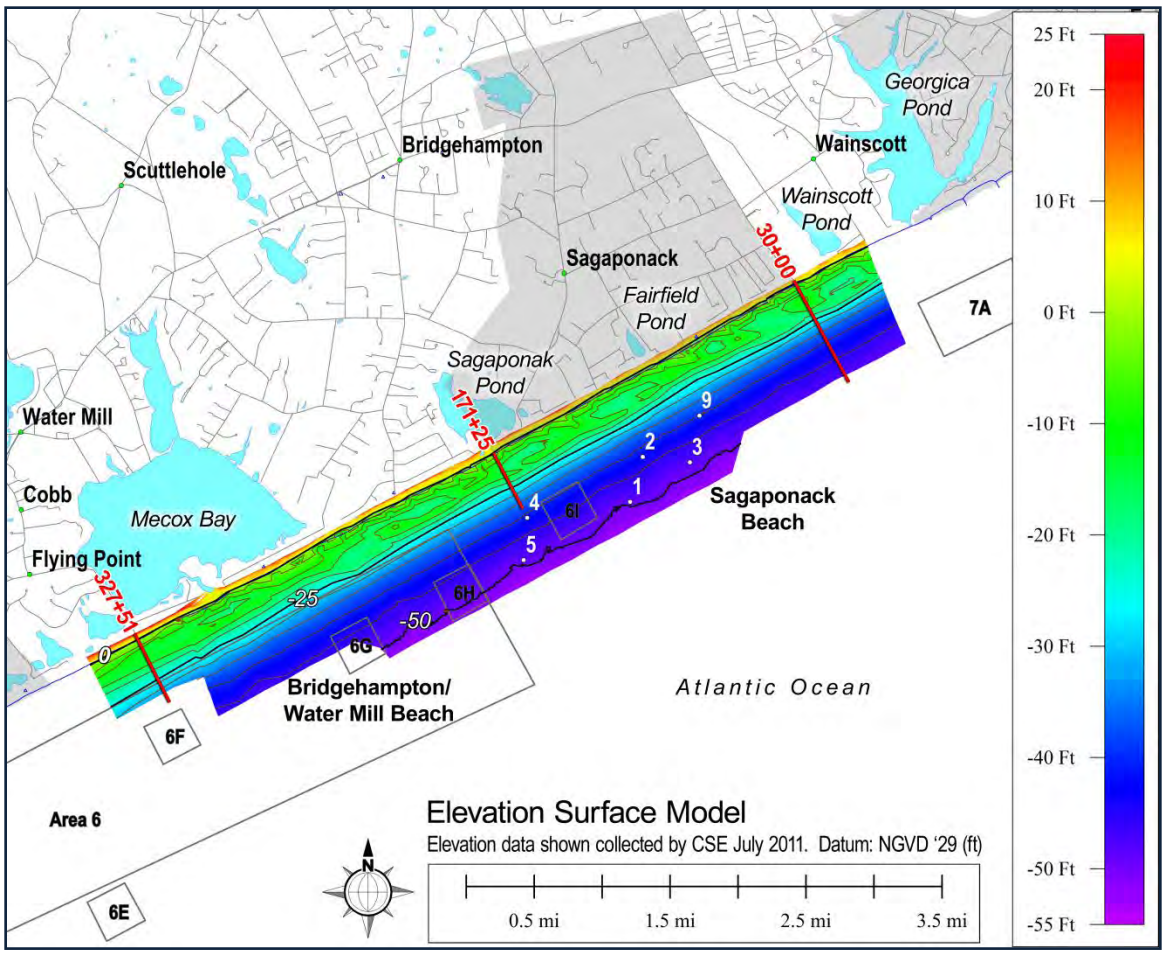


FIGURE B. Results of a condition survey in July 2011. The digital terrain model (DTM) was developed by the team from profiles collected at 500–1,000-ft spacing and continuous LiDAR imagery in the dunes between the baseline and ~4,500 ft offshore.

Combining the sand deficit in the foredune (with respect to FEMA-recommended criteria for 100-year storm protection) and the deficit across the beach and inshore zone, the team determined that Reach 3 (7,875 linear feet of beach) requires 120,000 cubic yards (cy) and Reach 4 (7,751 ft) requires 80,000 cy to produce a minimum healthy profile.

Annual erosion rates from 1955 to 2011 range from 2.0 to 5.8 cubic yards per foot per year (cy/ft/yr), depending on the period covered by available data. The weighted average annual erosion rate over the past ~55 years has been 4.0 cy/ft/yr. The team formulated the beach restoration plan based on an adopted rate of 3.5 cy/ft/yr, which corresponds with best-available data from the period 1979 to present. This equates to average sand losses totaling ~55,000 cy each year along the Bridgehampton-Water Mill Beach.

A property with 100 ft of frontage along the beach has been losing ~300–400 cy/yr over the past several decades. This is equivalent to ~25 large dump trucks of sand removed each year in front of one house. At this loss rate, the seaward dune vegetation line is expected to migrate ~35–70 ft inland over the next 10 or 20 years (respectively). Properties having less than 35 ft of vegetation between the beach and structures are most susceptible to storm damage in the next decade.

Ten-Year Nourishment Requirement

The team developed 5-year, 10-year, and 20-year beach restoration plans calling for 575,000 cy, 950,000 cy, and 1,700,000 cy (respectively). The ten-year plan is recommended as the most practicable plan considering economies of scale and the greater uncertainty of 20-year plans. The ten-year plan incorporates an additional volume (120,000 cy) in Reach 3 and a comparable volume (80,000 cy) in Reach 4 to feed the dune system over time. The plan applies an additional 35 percent safety factor (extra volume over the length of the beach) to account for uncertainties and variability of loss rates from year to year.

Sediment Quality and Potential Borrow Sources

Sediment quality on the beach was determined via sampling. The "native" beach consists of moderately-sorted medium sand with a mean grain size of 0.41 millimeters (mm) (based on 60 samples along Bridgehampton-Water Mill Beach and Sagaponack Beach).

The USACE has identified several potential borrow areas off Mecox Bay including a 90-acre area designated 6F and similar areas off Dune Road (6G) and the western end of Bridgehampton Beach (6H) (Fig C). CSE collected six borings for the present study and determined that all contained beach-quality sediment with negligible mud. Two of the borings (SAG-03 and SAG-05) obtained in ~50-ft depths about 1 mile offshore of Bridgehampton-Water Mill–Sagaponack are deemed to have the most similar quality sediment as the native beach. CSE core SAG-05 is situated on the eastern side of USACE 6H at the eastern end of Bridgehampton Beach. Pending confirmation via additional borings (applies to USACE-designated and CSE-designated borrow areas), an area ~3,500 ft long and ~1,200 ft wide centered on SAG-05 (Fig C) could potentially provide over 1.2 million cubic yards if dredged to ~8 ft below the seabed.

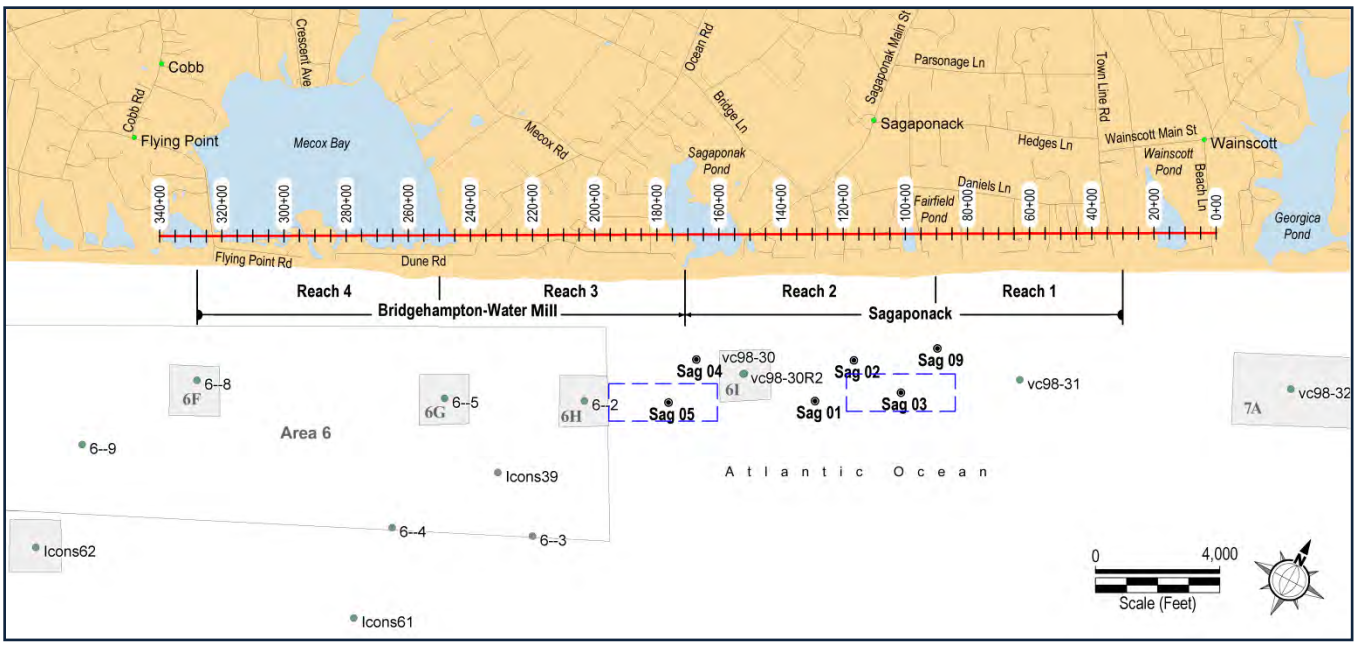


FIGURE C. Location of USACE cores, CSE cores (SAG-series, this study), and USACE-designated borrow areas. [Source: USACE 2008]

Sediments around SAG-05 have an average grain-size of 0.46 mm, indicating they would perform well as nourishment material. If borrow sediments are finer than the native beach, much more volume is required to achieve a given dry-beach width.

Assuming a viable borrow area can be confirmed around the 50-ft depth contour off Bridgehampton Beach, excavations by ocean-certified hopper dredge or cutterhead suction dredges is feasible during fair-weather periods. Hopper dredging is likely to be favored if the dredging window is limited to winter months because these vessels can operate in higher wave conditions.

Environmental Impacts

The primary environmental impacts that apply in the Bridgehampton–Water Mill setting for projects of this type are changes to biota in the borrow area and on the beach (particularly surf clams, a commercial species), impacts to threatened and endangered species (particularly piping plovers), and impacts to water quality. Sediment quality is the most important variable that can be controlled. Borrow areas containing beach-quality sand with negligible mud, gravel, or cemented limestone fragments tend to reduce turbidity and minimize adverse impacts.

Recommended Plan

Figure D summarizes the recommended nourishment plan for Bridgehampton–Water Mill Beach assuming an offshore borrow area about 1 mile offshore (see Fig C) is permitable. Table A presents a realistic range of cost scenarios based on similar project experience. The recommended plan would provide a range of profile volumes differing by reach. Figure E illustrates the typical nourishment sections and areas of impact across the littoral zone by reach.

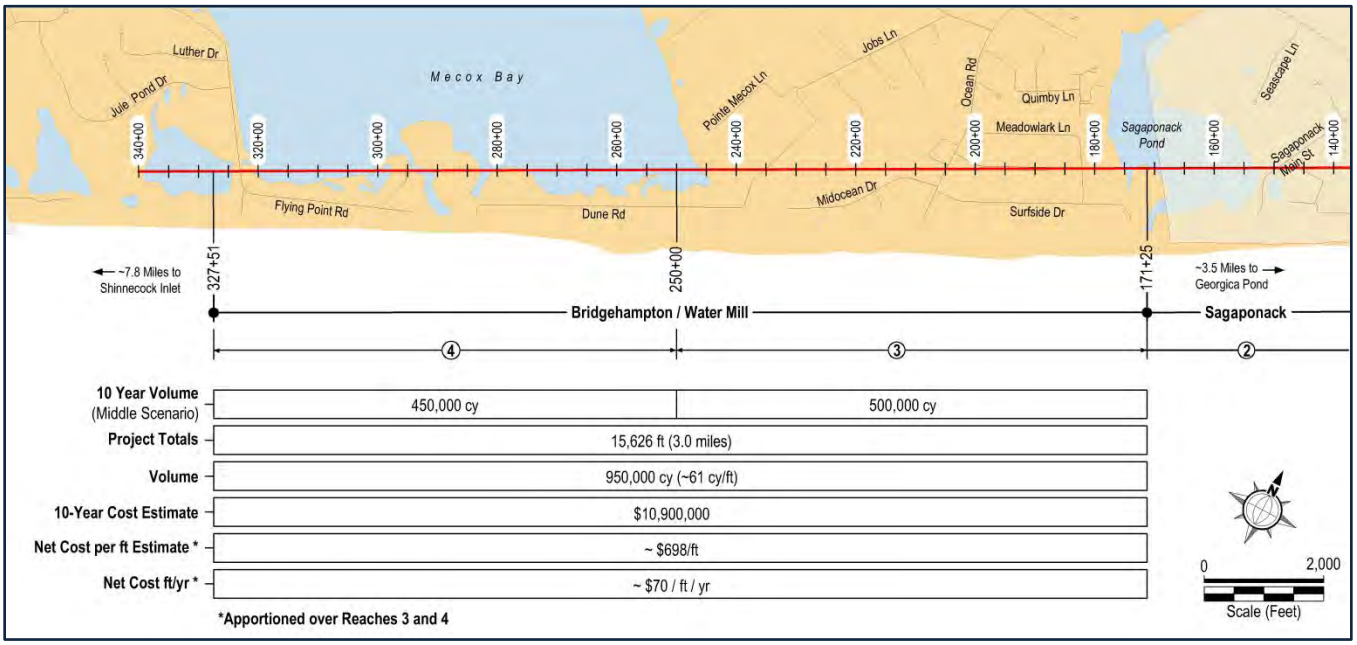


FIGURE D. Recommended "ten-year" beach restoration plan for Bridgehampton–Water Mill involving ~950,000 cy from the USACE-designated offshore borrow areas (as available) or CSE-designated borrow areas. [All areas to be confirmed via additional borings. See Figure 2.34 for potential borrow areas.]

TABLE A.

Beach restoration plan for Bridgehampton–Water Mill Beach — "ten-year project."

Offshore borrow sources USACE 6F, 6G, 6H, or CSE (SAG-05) are assumed feasible for construction.

The low and high scenarios are ±15 percent of the middle (recommended) plan and considered to provide a realistic range of outcomes at the time of bids to assist the community in establishing a fixed budget (not to exceed) for the project.

Unit Cost Assumptions:	Dredging @	$ 8.25	per cubic yard
	Mobilization/Demobilization @	$ 2,000,000	

Notes: Unit cost estimate is based on recent projects at Smith Point (NY) and Nags Head (NC).

Mobilization/Demobilization cost is based on recent project at Westhampton (NY), and assumes Sagaponack is constructed at the same time with shared mobilization.

CSE Recommended Ten-Year Plan — Middle Scenario

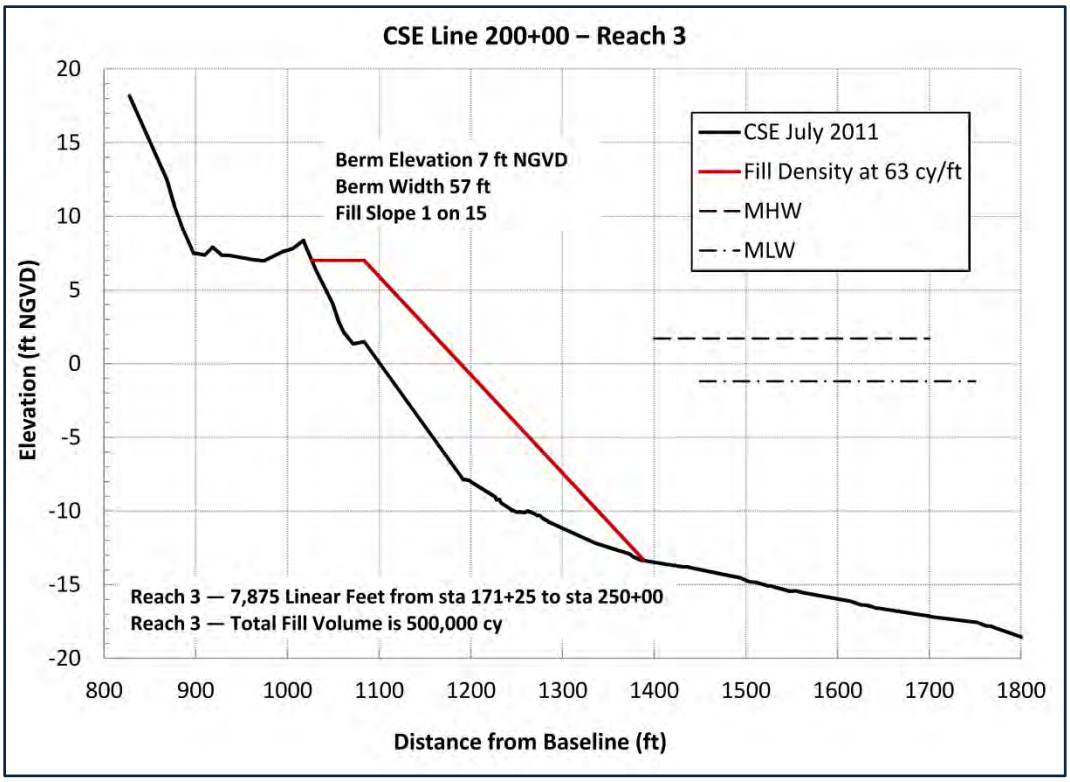
Reaches	Reach Limits	Length (ft)	Nourishment Volume (cy)	Average Unit Volume (cy/ft)	Pumping Costs
Reach 3	**171+25-250+00**	7,875	500,000	63	$ 4,125,000
Reach 4	**250+00-327+51**	7,751	450,000	58	$ 3,712,500
Totals	**171+25-327+51**	15,626	950,000	61	$ 7,837,500
				Mobilization/Demobilization	$ 2,000,000
				Final Design, Surveys, Engineering, Construction Admin @ 6%	$ 590,250
				Permitting and Environmental Reports @ 2%	$ 196,750
				Contingency @ ~3%	$ 275,500
				Total Project	$ 10,900,000
				Cost per Linear Foot of Beach	$ 698

CSE Recommended Ten-Year Plan — Low Scenario

Reaches	Reach Limits	Length (ft)	Nourishment Volume (cy)	Average Unit Volume (cy/ft)	Pumping Costs
Reach 3	**171+25-250+00**	7,875	425,000	54	$ 3,506,250
Reach 4	**250+00-327+51**	7,751	382,500	49	$ 3,155,625
Totals	**171+25-327+51**	15,626	807,500	52	$ 6,661,875
				Mobilization/Demobilization	$ 2,000,000
				Final Design, Surveys, Engineering, Construction Admin @ 6%	$ 519,713
				Permitting and Environmental Reports @ 2%	$ 173,238
				Contingency @ ~3%	$ 245,175
				Total Project	$ 9,600,000
				Cost per Linear Foot of Beach	$ 614

CSE Recommended Ten-Year Plan — Upper Scenario

Reaches	Reach Limits	Length (ft)	Nourishment Volume (cy)	Average Unit Volume (cy/ft)	Pumping Costs
Reach 3	**171+25-250+00**	7,875	575,000	73	$ 4,743,750
Reach 4	**250+00-327+51**	7,751	517,500	67	$ 4,269,375
Totals	**171+25-327+51**	15,626	1,092,500	70	$ 9,013,125
				Mobilization/Demobilization	$ 2,000,000
				Final Design, Surveys, Engineering, Construction Admin @ 6%	$ 660,788
				Permitting and Environmental Reports @ 2%	$ 220,263
				Contingency @ ~3%	$ 305,825
				Total Project	$ 12,200,000
				Cost per Linear Foot of Beach	$ 781



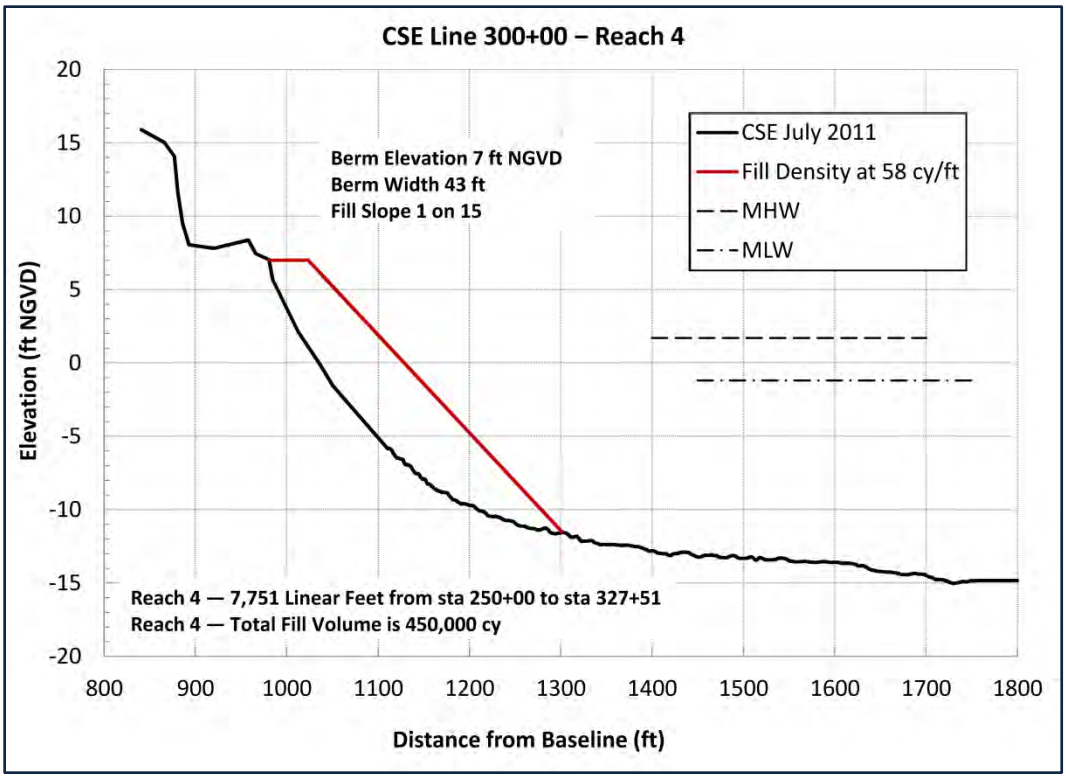


FIGURE E. Representative nourishment profiles for Reach 3 (eastern half) and Reach 4 (western half) of Bridgehampton–Water Mill Beach based on the recommended plan. Profiles with average fill densities of ~60 cy/ft are expected to widen the beach by ~65 ft after normal adjustment.

ACKNOWLEDGMENTS

This report is prepared at the direction of the Bridgehampton–Water Mill (NY) Erosion Control District (ECD) under an agreement between the Town of Southampton and First Coastal Corporation. It is preliminary to submitting a permit application for beach restoration. First Coastal, as prime consultant, retained the firms of Coastal Science & Engineering Inc (CSE – Columbia SC) and Sea Level Mapping (Wading River NY) to assist with engineering and surveying.

The First Coastal team thanks the Town of Southampton for their support of the project (Supervisor Ana Throne-Holst and the entire Town Board), the Southampton Town Trustees, Chris Bean (Parks & Recreation), Jennifer Garvey (Supervisor's Office), Lt Robert Iberger (Emergency Management), and Marty Shea (Environment). We also thank Dave Lederman, Jeff Lignelli, Jack Rosen, and the ECD Advisory Committee for their support and guidance during the study. Some of the information herein was obtained through Town archives as well as First Coastal and CSE archives.

Our team drew on previous work by the US Army Corps of Engineers–New York District, and we especially thank Lynn Bocamazo (senior coastal engineer) and Christina Rasmussin (coastal engineer) for providing offshore borrow data. The authors also acknowledge the District and New York Coastal Partnership (Babylon) for support of Dr. Kana under Contract DACW 51-81-C-0030 (FIMP Reformulation Study) and a grant to prepare regional sediment budgets for the area. We also benefitted from research by Dr. Julie D. Rosati and colleagues at the USACE–Environmental Research & Development Center (Vicksburg MS) who prepared sediment budgets for the period 1979 to 1995 referenced herein. We also obtained beach survey data from New York State and thank Jay Tanski (NYS Sea Grant Extension Service specialist) for his assistance. Dr. Henry Bokuniewicz is also thanked for his research on the Georgica groins and helpful discussons over many years.

For the project team, Aram Terchunian (First Coastal) is project director assisted by Billy Mack Andrew Baird, Regina Grant, Mathew Quinn, and Sandra Segelke. Field data collection was performed by Philip McKee (CSE), Dennis Burns (CSE), Trey Hair (CSE), and Mathew Quinn. Bob Fox (PLS) provided baseline control and QA/QC of the data collection procedures of the team. Data reduction and analysis were directed by Dr. H. Kaczkowski PE (CSE senior coastal engineer, NY 090164) with assistance by CSE staff–Steven Traynum and Philip McKee. Trey Hair and Diana Sangster of CSE prepared the graphics and manuscript. The authors of the report were Tim Kana, Haiqing Kaczkowski, and Aram Terchunian.

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