FACT SHEET #5
Nags Head Emergency Nourishment Project

TOWN OF NAGS HEAD – LOCALLY FINANCED BEACH NOURISHMENT

COST OF DO-IT-YOURSELF DREDGING OPERATION

Q. *How much would it cost for the town to acquire a dredge and perform the work on its own?*

A. The capital costs for establishment of a dredging operation capable of ocean operations for dredging and disposal on a beach are in the range of $150 million. Operating costs for such an operation are estimated conservatively at $20 million per year.

In addition to the costs, an individual starting a dredging operation must also consider the substantial risks and the uncertainty associated with such an operation. The costs and risk are significant enough that a very small number of corporations based in the United States have the capability to take on ocean-based beach nourishment operations: Great Lakes Dredge & Dock Company, Weeks Marine, Manson Dredging (West Coast company) and possibly, Norfolk Dredging Company.

BACKGROUND

This information sheet is provided to the Town of Nags Head in response to questions from members of the town's Board of Commissioners related to the costs associated with performing beach nourishment with town-owned and operated dredging equipment. The concept investigated here involves the town or another business entity purchasing the equipment necessary to conduct dredging and beach nourishment operations separate from the dredging companies that perform similar work in North America, most notably of those companies being Weeks Marine and Great Lakes Dredge & Dock Company.

To prepare this information, we had first-hand discussions with Larry DaVico, an engineer with Weeks Marine in New Orleans (Louisiana), Bill Hanson with Great Lakes Dredge & Dock Company in Oak Brook (Illinois), and IHC Holland of the Netherlands, a builder of hopper dredging vessels in the Netherlands. The costs shown are averages from the costs provided by the correspondents.

THE BEACH NOURISHMENT OPERATION

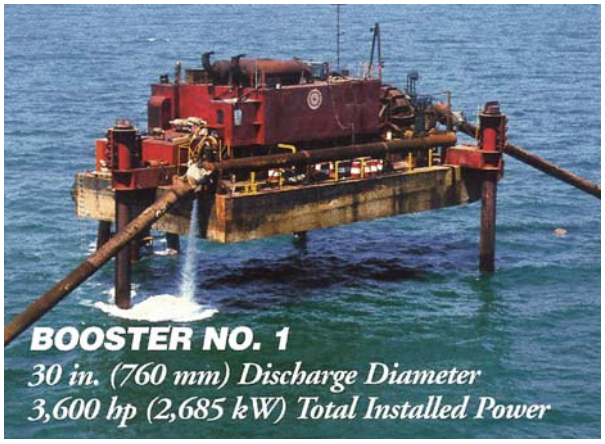
The typical beach nourishment operation consists of the following equipment and personnel components:

- The dredging machine which may be a stationary hydraulic dredge (also referred to as a cutterhead dredge) or an ocean-going hopper dredge.

CUTTERHEAD DREDGE

HOPPER DREDGE

- Booster Pump Operation: When pumping distance from the dredge to the beach exceeds the pumping capacity of the dredge itself, it becomes necessary to add additional pumping capacity in the pipeline to boost the flow of the slurry. This equipment typically consists of a barge with a large pump, electric generator, and auxiliary equipment necessary to operate and maintain the pumps. The pumps are large, in the 6,000–16,000 horsepower range. The barges are usually free floating, requiring a heavy duty anchoring system or are situated on jack-up barges. The free-floating barges have operational limitation similar to the hydraulic dredge in terms of the wave climate in which it is safe to man and operate the equipment. Jack-up barges elevate the deck above the water to avoid sea-state related risks.



- Dredge Anchoring Operation: Operation of the hydraulic dredge anchoring and positioning process requires at least one tug boat (typically in the 80-ft category with an experienced crew and a lifting barge). This operation is responsible for relocating the positioning anchors for the hydraulic dredge that allow the dredge to rotate and move in the dredging area. As the dredge moves through the borrow area, the anchors must be repositioned so that the proper scopes are maintained.

- Dredge Crew: The crew to operate and maintain the dredge usually consists of two crews working two 12-hour shifts per day with one crew on leave. In the case of hopper dredges, the crews are berthed on the dredge continuously. This requires berthing and food preparation facilities on the dredge. In the case of hydraulic dredges, the crews are ferried to and from the dredge twice daily for the shift changes.

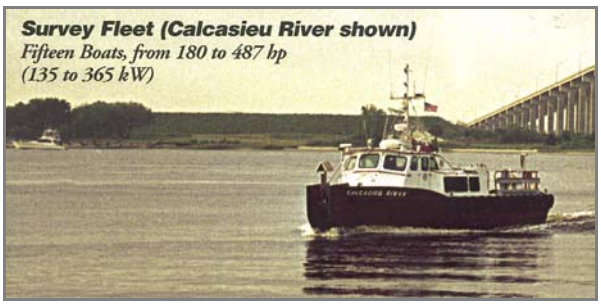
- Submerged Pipeline System: The submerged pipeline and mooring system connect the dredge pipeline to the shore pipe system. This system consists of a combination of flexible pipeline and steel pipe, typically 24–30 inches in diameter, depending on the discharge diameter of the dredge. In the case of hopper dredging operations, a single-point mooring buoy is required at the connection point so that the dredge vessel can moor to the same structure supporting the submerged pipeline. This connection is made by the dredge crew each time the dredge is loaded and ready to unload. The buoy and submerged pipeline connection must also be constructed in such a manner that the connection can be made safely in the full range of sea-state conditions experienced.

- Shore Pipe System: The shore pipe system typically consists of a minimum of 3,000–4,000 linear feet of steel pipe (24–30 inches in diameter) in 50-ft sections. Use of the pipe must be managed to maximize pipe life. The pipe must be rotated periodically so that, over the life of the pipe, abrasion of the inside of the pipe is distributed over the entire circumference

of the pipe. The worst abrasion is along the bottom third of the pipe.

- A Shore Pipe Management Crew: As the beach project extends away from the shore pipe landing point, pipe must be added to extend the beach fill down the beach. Specialized front-end loader equipment modified for handling pipe and an experienced shore crew are required for lifting, transporting, and fitting the pipe together so that it does not leak under pressure.

- A Crew Boat and Operator: A minimum of one crew boat is required for the dredging operation. This crew ferries dredge personnel to and from the dredge, delivers food and stores to the hopper dredge, and often serves double duty as the hydrographic surveying vessel.



- Beach and Hydrographic Survey Crews and Engineers: The survey operation is actually a small, mobile engineering company. Each beach nourishment operation requires an engineer and survey crews to perform and analyze data from the before and after fill conditions on the beach and from hydrographic surveys of the borrow area if required. The beach surveys extend beyond wading depth, requiring specialized equipment, such as CRAB (coastal research amphibious buggy) or swimmers, for shallow water surveys. The surveying operation also requires full-time office space with computers and plotting equipment, as well as the purchase and maintenance of surveying equipment, either total stations or RTK differential GPS equipment.

- Beach-Grading Equipment and Operators: At least two large bulldozers (typically three) are required in the D8 or D9 class for grading the sand as it is pumped onto the beach. This operation requires an experienced crew to manage the sand as it flows from the pipeline, build settlement dikes to minimize the amount of sand lost to the surf, and then finish grade the beach to the grades required. The dozer operators that do this work have specialized knowledge and experience with beach nourishment operations.

- Welding and Maintenance Crew: A beach nourishment operation will typically include several people who are welders and mechanics that do nothing but repair pipe, dozers, and dredge equipment.

- The Project Management Staff: The project staff, usually housed in temporary offices, includes the project superintendent, project clerk, and clerical personnel. The office is equipped as any office would be, including furniture, computers, telephones, internet service, copy machines, and equipment for the engineering and survey staff.

- Pipe Transportation Operation: Pipe, bulldozers, and other beach equipment are transported from one job site to another, using either rental or owned over-the-road trucks capable of hauling heavy loads significant distances. For hauling shore pipe alone (for 4,000 linear feet of pipe), 15–20 loads of steel pipe must be loaded, transported, and unloaded at the next job site.

- Certification and Dry-Docking Operations: To maintain the dredge certification to Coast Guard requirements, the dredge must be put into dry dock every three years for periodic maintenance and Coast Guard inspection and certification.

RISKS ASSOCIATED WITH DREDGING

The dredging business is a highly risky business. There are a multitude of risk factors, a few of which can be managed. Some of the risks are described as follows.

- Limited Operational Time Frames: In most of the coastal areas of the United States, dredging is permitted during a narrow time window of each year from mid November through March and April, depending on the location. This means that to recoup the costs associated with owning and operating a dredge system on a profitable basis, sufficient revenue-producing work must be performed during that period to cover the overall annual costs of dredge ownership and operations.

- Personnel Risks Associated with Limited Time Frames: The risks associated with this limited operational window involves hiring and keeping qualified and experienced staff and crew. Much of the field crew required for beach nourishment operations do not work on the dredge and must be laid off when revenue-producing work is not available. Since the work is specialized, the project sites far from home, and the hours long, the dredging companies typically have difficulty obtaining qualified crew.

- Mechanical Equipment: The dredging operation involves the coordinated operation of a group of complicated mechanical systems. One of the measures of the success (profitability) of a dredging operation is the amount of downtime associated with mechanical failures and weather. When any part of the mechanical system fails, the entire operation must shut down. This can be for a $25 or a $10,000 part on the dredge, booster pump, or pipe system.

- Weather Risks (Acts of God): Each beach nourishment location has a unique operational environment characterized by wind and wave conditions. Some locations have a safe harbor nearby where dredges and other equipment can take refuge in case of inclement weather and sea-state conditions. The safe harbor must have an access channel sufficiently deep and safe to accommodate dredges and tug boats. If the harbor of refuge is not close by, as is the case with Nags Head, dredgers must constantly monitor weather predictions and, in the event of a forecast of unsafe conditions, they must shut down operations and move equipment to a safe harbor. At Nags Head, this involves moving a hydraulic dredge by tug to a safe harbor in the Hampton Roads area, a one-day sail away. Hopper dredges are self-propelled and can run to the safe harbor under power. In either case, there is a significant loss of production time. Time is lost for the time it takes to move to and from the safe harbor and the time it takes to re-establish operations after returning to the job site. Weather conditions can result in damage to the submerged pipeline and connection, adding additional risks and extending the restart time even more.

- Environmental Risks: Many beach nourishment projects are carried out in pristine ocean environments subject to extensive federal, state, and local regulations. The quality of the sand dredged to the beach can be predicted but not guaranteed.

  There are risks associated with endangered species. Operations can be shut down if a hopper dredge takes one or more sea turtles in the process of dredging in the ocean. In North Carolina locations, turtles typically appear when water temperatures exceed 56 degrees. But, the turtles have been known to appear during colder water conditions. The handling of hydrocarbons on the dredge is subject to close scrutiny by the U.S. Coast Guard. Fueling and maintenance operations always represent a risk of spills and subsequent scrutiny by regulatory authorities. These are a few, but by no means all, of the environmental risks.

- Insurance Risks: Dredging operations in the ocean and coastal areas are hazardous business. The risks to personnel and equipment

must be insured against catastrophic financial losses should there be an accident or damage to equipment caused by acts of God or other causes. The cost of insurance, as one can imagine in today's insurance-costs climate, is significant.

SOME ESTIMATES OF COSTS ASSOCIATED WITH DREDGING OPERATIONS

The costs provided are generalized and include capital costs and operations costs. Exact costs are not readily available. Dredging companies do not reveal those costs for competitive reasons. They have provided some general costs and operations multipliers that are applied here.

Capital Costs

Hopper Dredge: Hopper capacities from 5,000 cubic yards (cy) to 8,000 cy. Constructed in the Netherlands. Range of costs depending on size and equipment options – $60 to $100 million. Last dredge purchased in the United States was the *Liberty Island* (Great Lakes Dredge & Dock Company); it cost $63 million. That price was five years ago, and current costs are estimated to be (~)$100 million.

Hydraulic Dredge: Ocean-certified cutterhead dredge – $45 million. Last cutterhead dredge delivered in the United States was to Manson Dredging at a published cost of $35 million. That dredge was constructed in Manson's yard using a significant number of parts already on hand. Actual costs, if purchased on the open market, would be $45 million.

Booster Pump: Booster pump prices vary greatly due to the different operational parameters required by each contractor. A "standard" pump used for nourishment projects costs between $100,000 and $200,000. The barge and associated generators would add several million dollars to this cost. [Note: Booster pumps would generally not be needed for a hopper dredge operation but would be needed for a cutterhead operation – total cost (~)$4 million.]

Earth-Moving Equipment: Nourishment projects use three D-8 or D-9 bulldozers ($330,000 each) and one front-end loader ($300,000). The bulldozers shape the beach while the front-end loader relocates the pipe along the beach. Total cost (~)$1,300,000.

Surface Pipe: Three to four thousand feet of surface pipe ($170 per linear foot) are needed to transport nourishment slurry onto the beach. Total cost (~)$500,000 to $700,000.

Submerged Pipeline: Three to four thousand feet of submerged pipeline with a single-point mooring connection costs (~)$1 million.

Miscellaneous Equipment: This includes field and office equipment typically associated with a nourishment project. Average costs are usually $100,000 per year.

Survey Equipment: Required for all projects to ensure correct amount of sand was pumped, correct profile shaped, and proper sediment compatibility. Typical cost range from $30,000 to $150,000 for survey equipment. Total cost (~)$100,000.

Operating Costs: Operational costs are 85 percent of the total capital cost annually. This includes personnel, insurance, fuel, maintenance, field, and home office operations. Total cost (~)$20 million, assuming capital costs totaling (~)$150 million amortized over approximately six years.

Great Lakes Dredge & Dock Company just completed the Town of Edisto Beach's (South Carolina) beach nourishment project. They used 40 people (on-site) for the duration of this project (~2 months).

[Photos courtesy of Great Lakes Dredge & Dock Company 2006 calendar]