



UNIVERSITY OF WISCONSIN SEA GRANT INSTITUTE

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Working With Engineers and Contractors on Shore Protection Projects

GREAT LAKES SHORELINES CONTINUE TO EVOLVE, and many of them have been retreating for thousands of years. As the shoreline has retreated, there has been a corresponding erosion (or down-cutting) of the lake bed in many places. Stopping these natural processes is complex because of the consequences to other sections of the shoreline, the variability in shoreline soils and geometry, and the complexity of the processes that erode the shoreline. Natural processes (including the freezing and thawing of water) impact the function of shore protection structures.

Shore protection as a do-it-yourself project is often a series of short-term experiments in a vain and costly search for a long-term solution.

Experienced coastal engineering professionals have the expertise necessary to influence the success of a shoreline project, including the permitting process, public and neighbors' responses to the planned project, construction and maintenance costs, management and the performance and life of the project. They can monitor the project following completion and plan any modifications or repairs needed after major storms. An investment in the services of experienced professionals is the best way to ensure the long-term success of a coastal protection project and minimize costs during the period of ownership.

The steps of typical shore protection projects that go beyond surface water control and revegetation of slopes are shown in the box to the right.

Typical Steps of a Shore Protection Project

- Selecting technical advisors or consultants
- Identifying the property owner's needs and expectations
- Conducting field investigations
- Analyzing and designing by consultants
- Preparing and submitting permit applications to regulatory agencies
- Modifying the designs (if needed) and securing permit approvals
- Soliciting bids and selecting a contractor
- Observing construction
- Monitoring the shore protection at least annually and after major storms
- Repairing and replacing the shore protection as needed

For shoreline projects, we recommend retaining a professional with experience undertaking similar projects. A professional experienced in coastal slope stability and erosion control may be registered as a geologist, geoscientist or engineer. A professional experienced in the design of coastal shore protection structures is likely to be a coastal engineer registered as a professional engineer (P.E.). Request and contact references provided by prospective consultants of clients for whom similar work was done.

Benefits of a Professional

Professionals can describe how the shoreline has been naturally changing, including the rate of shoreline retreat and the presence (or absence) and significance of lakebed erosion. They can describe the long-term and short-term consequences of halting that retreat at particular locations. They can also estimate wave conditions approaching the shore, predicted variations in water levels, discuss

Issues

- Eliminating shoreline retreat
- Protecting the shore from the damaging action of waves and ice
- Stabilizing coastal slopes
- Developing recreational amenities, such as beaches and beach access
- Minimizing damage and protecting or enhancing environmental habitat

potential climate change concerns and the action of ice. A coastal slope stability expert provides technical guidance on intercepting groundwater, controlling surface water and stabilizing lakeshore slopes. An engineer experienced in shore protection structures understands the advantages and disadvantages of each protection option; the features important to achieving the desired performance; specifications adequate for the wave, current and water-level exposure; and the risks and reliability inherent in making each design decision. These professionals are experienced in developing solutions acceptable to, and understood by, their clients. The initial work generally consists of the steps shown in the following box.

Initial Work of a Shore Protection Consultant

- Discussing the property owner's needs and expectations
- Making site visits, surveying and collecting data
- Reviewing information about the site (including shoreline and nearshore slopes, and slope properties and conditions) and obtaining any essential missing information
- Determining site exposure to waves, currents and water levels
- Preparing a technical study and evaluation of alternatives related to site features, conditions and exposures
- Designing slope modifications and structures
- Preparing plans, specifications and bid documents
- Helping secure a contractor and overseeing construction

Basic Information to Expect in a Shore and Slope Protection Design

- Storm conditions, water levels, surface water, groundwater and ice conditions for which the project is designed
- Basic shapes, slopes, conditions and properties of the coastal environment and nearshore lakebed
- Regulatory and environmental impact issues involved in the design and measures to minimize adverse impacts
- Probable adverse impacts of the design on neighboring properties
- Probable adverse impacts of neighbors' actions on the design
- Steps needed to maintain the desired quality of construction
- Condition monitoring of the completed work and steps needed to repair/replace damaged elements

Elements of a Typical Shore Protection Design

A designer of shore protection solutions should provide the following information and features in a design:

- A stated specific life expectancy (design life) based on the owner's needs.
- A statement of specific extreme combinations of stormwater levels and storm wave conditions to be met by the designed solution.
- A statement of the probability (or percentage chance) that excessive damage will occur over the expected period of ownership based upon the owner's understanding and acceptance of that risk.
- A design based on a prior determination and statement that lakebed erosion does or does not significantly occur lakeward of the owner's property.
- Plans that avoid overtopping by storm waves or accommodate it in a way that minimizes damage.
- A design that provides flank protection (if required).
- A design that provides toe protection from wave scour and lakebed erosion (if required).
- Plans that show proper preparation of any structure foundations to prevent future settling of the structure and loss of soil behind the structure.
- Plans that include detailed dimensions and elevations referenced to a local or national datum.

Once the owner has decided, with professional advice, which slope stabilization measures to use and what shore protection structures to build, bids can be solicited from contractors with the assistance of the engineer. Nearly all decisions that affect the final cost of the solution will be made with the engineer before the structure is built. These decisions will affect initial cost, maintenance costs and the expected life of the slope stabilization and shore protection system. During construction, the engineer can assist the owner by evaluating the contractor's bid, representing the owner through administration of the construction contract and monitoring the contractor's work.

Benefits of a Contractor

The contractor and subcontractors should be experienced in working on shoreline projects. This is expected whether that work is in vegetation selection and planting, groundwater control, or slope stabilization and construction of shore protection structures such as armor

stone revetments or concrete seawalls. The contractor is responsible for taking the design prepared by the engineer and building the solution at the project site in conformance with the plans and specifications. A typical contractor will perform the steps listed in the box below.

Working With a Contractor

Typically, the contractor will:

- Submit a bid to do the work as designed, execute a construction contract and stay within budget.
- Mobilize material and equipment on-site.
- Provide people to manage and complete the construction.
- Meet on a regular basis with the owner and engineer to review progress and resolve problems as they arise.
- Demonstrate that the work is being performed in accordance with the plans and specifications.

The importance of obtaining a competent contractor to build the engineer's solution cannot be overstated. Do not assume the contractor with the lowest bid should be awarded the construction contract. A low bid may reflect inexperience in construction of coastal works. If the construction quality is poor, the structure will require a high degree of maintenance (or early replacement), resulting in long-term costs that may be higher than the overall costs of an adequate structure. Coastal construction on the land/water boundary of the Great Lakes is a specialty. Review works already completed by the contractor.

Selecting Professionals

Registration and licensing alone provide no assurance that a person is qualified and experienced as a professional consultant or contractor in designing and building slope stabilization, erosion control and shore protection structures. A good way to select a consultant is to use a qualification-based selection (QBS) procedure that is a recognized and tested method for selecting consulting engineers. The procedure has eight common-sense steps shown in the following box. It can be used on large and small projects, done simply, or in substantial detail. The procedure can also be used to develop a list of prequalified construction contractors.

The main purpose of using a QBS process is to decide if there are adequate indications that applicants can meet your goals. Note that experience of the on-site supervisor(s) is not necessarily the same as the applying firm. Look for:

- Experience in the type of work needed.
- Performance on past projects, including the ability to complete projects on time, within estimated cost and with good quality of construction.
- Experience of the on-site construction supervisor(s). Contact references about their work.
- A history of defaulting on projects, and the ability of the contractor to obtain a bond.
- Forms of payment the contractor accepts.
- The contractor's procedure by which post-construction issues will be raised, monitored and resolved.
- The type of guarantee that is being offered.

A competent and confident contractor should have no concerns about offering a one-year guarantee on all material and workmanship.

A Qualification-Based Selection Procedure

Typically, the owner's representative will:

1. Read or review QBS materials and make a list of engineers and contractors to contact. (See the section titled "Sources of Information.")
2. Write out a brief statement of project goals and create a project description, a list of project needs, an approximate budget and a timetable.
3. Send a request for statement of qualifications with a copy of your project goals, description, needs, budget selection criteria and timetable to the engineers and contractors on the list. The engineers and contractors should respond with a statement of qualifications that includes lists of similar projects and references for these projects.
4. Evaluate responses to the request, and contact references. Statements from prospective consultants may indicate preferred contractors.
5. Interview two or three consultants and two or three contractors who seem to best fit your needs, and plan visits to selected sites with them where projects have been completed.
6. Select the most qualified consultant and negotiate a contract, including scope of service and compensation to be provided.
7. Notify firms not selected and thank them for their interest.
8. Once designs have been completed, work with your consultant to solicit bids from the list of prequalified construction contractors.



Sources of Information

These publications provide more information about coastal processes, slope stabilization and shore protection structures:

- *Living with the Lakes*. 1999. A 39-page booklet to help homeowners understand and adapt to Great Lakes water level changes. U.S. Army Corps of Engineers and the Great Lakes Commission. Copies available from the Great Lakes Commission, Eisenhower Corporate Park, 2805 S. Industrial Highway, Suite 100, Ann Arbor, Mich. 48104-6791.
- *Living on the Coast*. 2003. A 50-page companion booklet to *Living with the Lakes* designed to help people protect investments in shore property on the Great Lakes. U.S. Army Corps of Engineers-Detroit District and the University of Wisconsin Aquatic Sciences Center. Copies available from the University of Wisconsin-Madison's Aquatic Sciences Center.
- *Understanding Natural Hazards*. 2001. Ontario Ministry of Natural Resources. A 40-page booklet about the natural hazards of the Great Lakes-St. Lawrence River and large inland lakes, river and stream systems and a CD-ROM. Copies available from The Watershed Science Centre, Trent University, Peterborough, Ontario, Canada.

Find Qualified Professionals

- **Wisconsin Association of Consulting Engineers, Madison, Wisconsin.** A free QBS manual can be read or downloaded from the Internet. Search for "ACECWI."
- **Consulting Engineers in Ontario.** Phone 416-620-1400 or visit ceo.on.ca to find firms with capabilities in coastal engineering. Check with Professional Engineers Ontario (peo.on.ca).
- **Consulting engineers and geologists in the United States.** Online, search for marine engineers, consulting engineers, civil engineers, environmental engineers, coastal engineers, geologists or geoscientists. Contact state and provincial associations of these professionals. One such association is the American Institute of Professional Geologists.
- **Contractors experienced in working along the coasts of the Great Lakes.** Start by asking owners of completed projects nearby and your state or province permitting agency. Online, search for professionals in coastal cities. Many marine contractors are also dredging contractors and may be listed in the International Dredging Review's annual Directory of Dredge Owners and Operators/ Dredging Industry Buyer's Guide. Some contractors specialize in erosion control, slope stabilization, or biotechnical and soil bioengineering stabilization of slopes that may include experience with coastal slopes.

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Created with input from members of the Qualifications Based Selection Committee of the Wisconsin Association of Consulting Engineers.

