DEFINE THE PROBLEM:

The factors affecting shore erosion are the orientation of the shoreline, offshore depth, and the resistance of the shoreline to wave action. An individual assessment of your situation should be described in terms of backshore form, such as low bluff or high dune, offshore slope, and the existence or lack of a beach. Review the columns under type of shore on page 7 to determine what types of shore protective structures should be employed for various situations. Construction alternatives, pros, cons and costs are shown on subsequent pages. The cost estimates given are only a guide and will vary with locality.

SELECTING A PLAN OR PROTECTION

The cost of a structure, the risk and consequence of failure, and the materials available will decide the type of structure and its construction details.

The primary decision in contending with serious shore erosion problems is a choice of (1) relocation (2) armor the base or toe of the bank (3) build beaches or (4) reduce the force of the offshore waves. Relocation requires an alternative site for the home and a house-moving company. Armor requires good foundation conditions and the availability of heavy stone or other heavy material and access. Beach building requires artificial replenishment or an area where large quantities of beach material move along the shore. Devices which retain placed sand or entrap the natural littoral drift are offshore breakwaters, groins or, in the backbeach area, vegetation.

There is no single type of permanent or temporary protection that should be used in all cases. The most suitable type for individual selection can only be determined by consideration of specific information about the area to be protected, such as surveys, soil conditions, wave climate, set up, etc. The cost of protection varies considerably. Low-cost emergency protection can be provided for about $10 per foot, while permanent protection might cost up to $500 per foot of shoreline. Because of varying conditions of the shoreline around the various lakes, it is probable that the best plan of protection would involve a wide range of designs, depending on availability of materials and the severity of erosion. A number of these alternatives are described beginning on page 8.

The availability of materials will dictate the type of structure and its cost. For example, the lack of stone within economic hauling distance would require the use of some other material.

Some materials are very good, i.e., quarried stone, pre-fabricated concrete units, interlocking steel pile and creosoted wood timbers. Some materials are not acceptable such as junk cars, old tires, thin concrete slabs, and empty septic tanks, and may be against state law. In between these extremes is a range of materials that can be used if care, discretion, and ingenuity are applied to produce a more durable structure. Materials can be used in conjunction with other materials, for instance, wire fencing and stones; or quarried stone, cloth bags and grout; or steel sheet piles and quarried stone.

The desired life of the structure also dictates its type. Obviously, an untreated timber structure should not be installed where a structure is desired to last 50 years. Conversely, a permanent rubble-mound structure would not be required if the need for protection was of an expedient nature. The durability of the structure and its ability to absorb wave energy is also a factor.

The Corps prefers and recommends that permanent protective works be built, but understands that private owners usually can't afford the large cost. This means there may have to be departures from the standard designs for permanent protective works to provide some degree of protection against erosion. This will tend to decrease the first cost of construction; however, higher maintenance cost and reduced functional life will follow. The danger here is to underdesign the work and experience total failure. Close attention to the construction and maintenance guidelines given later in this pamphlet are needed to minimize losses.

BUILDING PROTECTIVE WORKS

Timeliness is the essence of the successful construction of shore protection measures. The best time to build shore protection structures is during low-water periods. Greater construction problems exist during high lake levels when many beaches are submerged making access difficult. The lack of time precludes an in-depth study of the problem, requiring a hasty solution.

Once the general plan of protection has been determined it should be discussed with the appropriate Corps of Engineer District, Permits Branch. The permit application will require your plan, and information on any borrow or disposal sites and may require 90 days to process.

The final design of protective works can proceed once the general plan of protection has been selected. The data herein describe the general plans. The final plan should include a layout drawing, construction details, and materials specifications. A complete alignment of the structure should be established as early as possible. Take advantage of the remaining beach and tie into adjacent shore protection works if possible. Provide enough room for the specified minimum slopes if you are building a revetment. As soon as the alignment is established, quantities can be estimated for establishing equipment and materials requirements.

Access roads and borrow areas should be identified on the plan. Local contractors and local officials can provide information on sources of material and load restrictions on streets and highways. The use of heavy equipment on residential streets can result in severe damage to the pavement.

Another important consideration is the selection of the proper equipment to do the work. Utilize the contractor's experience to establish the best use of equipment and the most efficient operation.

Contracts for shore protection works delineate the responsibilities of both parties, the owner and the contractor. The contract should be based on plans and specifications and include prices for the estimated quantities of work. It is important that both parties fully understand the scope of work. You should get "bids", i.e., prices, from a number of contractors,to insure obtaining quality work at the lowest price.

CONTRACT PLANS AND SPECIFICATIONS (TYPICAL)

For your protection, contract plans and specifications* should be provided to or by your contractor. This should include some, if not all of the following:

Location of the work with respect to the highway right-of-way and the shore.

Survey control and relation of elevations to lake levels and both expected highwater conditions and low water datum (LWD).

A typical cross-section indicating dimensions, slopes, arrangement and connections.

Quantity of materials (per lineal foot, per protection unit, or per job).

Relation of the foundation treatment with respect to the existing ground. Relation of the top of the proposed protection to design high water and low water datum.

The limits of excavation and backfill as they may affect measurement and payment.

Construction details such as weep holes and pervious materials associated with them.

Location and details of construction joints, cut-off stubs and end treatment.

Connections and bracing for framing of timber or steel.

*Sample specifications are shown on page 18.

Anchorage and splicing details, particularly size, type, location, and method of connection.

Number and arrangement of cables and details of fastening members.

Pile construction, the number of piles, length of piling, driving requirements, cut-off elevations, and framing details.

The details of adjustable wire baskets (gabions) and the material to be used to fill the baskets.

Concrete specifications, materials specifications, placement instructions, quality control and description of payment items.

Start-up and completion time for the work.

ENVIRONMENTAL CONSIDERATIONS

Since installation of shore protection devices usually produces some change in the nearby shoreline environment, thorough planning and design requires consideration of the full impact of the expected changes on the ecological and aesthetic value of the area to be protected. If the possibility exists of adverse environmental or social effects resulting from construction of a shore protection device, Federal and state law requires consideration of alternatives to avoid or mitigate the effects. Possible adverse environmental effects of a shore protection device are considered in the review process discussed previously under Permit Requirements. Expected shoreline changes that might be produced by some shore protection devices are discussed with other design aspects of the devices beginning on page 8.

SAFETY CONSIDERATIONS

Common sense safety is necessary to reduce the chance of injury and possible loss of life. Some safety considerations are listed below:

Safe access and safe working conditions must be provided at all work areas. Unstable bluffs must be graded to a safe slope.

A first-aid kit should be available. Everyone should be physically qualified to perform the work required. No one should expose themselves to injury.

Protective clothing, such as safety shoes, gloves, goggles, and hard hats should be worn by persons engaged in work requiring this protection.

Construction materials should be stored in an orderly manner on a solid, level surface.

Waste materials should be removed from the work area daily.

INSPECTION CONSIDERATIONS

Supervision of construction is very important. Close attention to detail is needed to assure the final design will perform as anticipated. Prior to and during actual construction make a complete review of the plan. A check list of the important items are described below.

- Start a pictorial record with pictures of existing conditions. Continue this through all stages of construction.
- Establish elevations of known points, layout line, and grade for construction.
- Note changes in the terrain that may require a change in the plan or the layout of construction.
- Check material sources for compliance with plans.
- Inspect work to insure compliance with plans.
- Record dimensions, limiting heights and depths on as-built plans.
- Maintain pictorial record throughout the life of the structure, particularly after damaging storms.