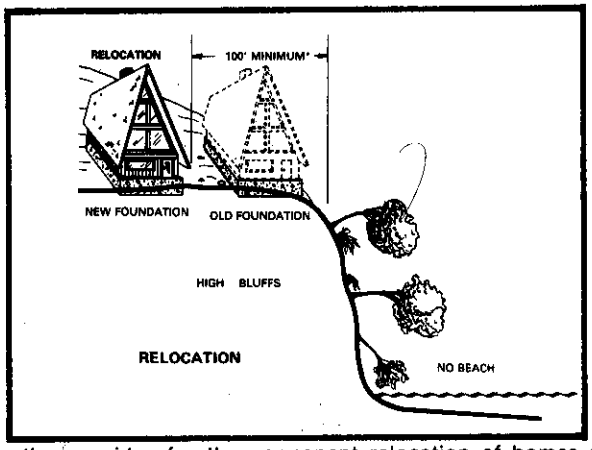
RELOCATION

Relocation is an alternative that cannot be overemphasized. Erosion is a natural geologic process that is extremely difficult to stop. The alternatives to build shore protection or to relocate must be weighed against the consequence of failure. Depending on the type of structure you might consider, it may cost the same to relocate as it would to build shore protection. Should a protective structure fail, then your investment in the structure is lost and your home or cottage is still in danger.



This alternative provides for the permanent relocation of homes subject to destruction by erosion-induced foundation failure. Relocation is accomplished by home movers. The important planning consideration is the rate of erosion. Key design considerations are the condition of the home, foundation and utilities, access and obstructions, length of move, new foundation and utilities.

NOTE:
Move 100' minimum or comply with state set back requirements.

Home moving is a highly specialized activity requiring a qualified home mover.

This alternative may be more economical than the installation and maintenance of shore protection.

RECESSION RATES
Long-term quantitative data on the rate of recession of a bluff or dune may be obtained from historic records of the area or the state. Early surveys and plat maps may contain survey points and a plot of the bluff line and shoreline as of the date of the survey. Utilizing these existing data, a new topographic map can be prepared showing the historic location of the bluff and shoreline and the present location. The distance between the old and existing location documents the amount of bluff or dune recession in the period of record.

The average cost of moving a typical home is about $10,000, excluding the cost of land. This cost includes house moving ($4,500), new foundation ($4,500), and utilities and service ($1,000). The cost of a new lot varies considerably depending on location.

ADVANTAGES

It is permanent. In the long run it may be the best method of protection.

Adaptable to short reaches of shore line.

Can be accomplished by the individual through contract with a house mover.

DISADVANTAGES

Special skills and equipment required.

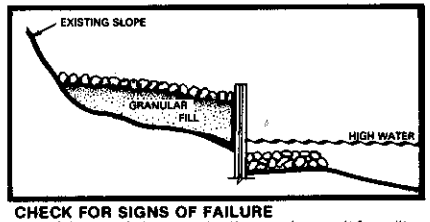
Area must be available for relocation of the house.

Does not stop erosion.

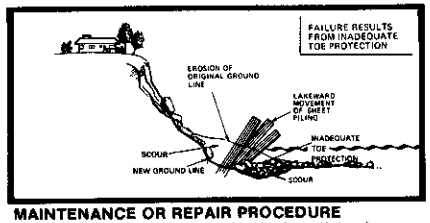
CONSTRUCTION AND

The following guidelines must be followed for any shore protection works built on the Great Lakes. If they are not followed the structure will inevitably fail after construction. Shore protection devices require varying degrees of maintenance depending on the type of structure and exposure to severe wave action. Establish familiarity with the symptoms of failure and the action that should be taken to maintain the structure. Construction rules and

RULE 1
Provide adequate protection for the toe of the structure so that it will not be undermined

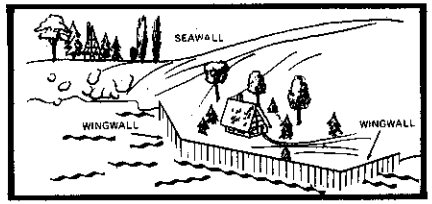


CHECK FOR SIGNS OF FAILURE
Most failures of shore protection works result from "toe failure", or erosion under the lowest part of the structure. Failure of the bulkhead can be prevented with adequate toe protection. Toe protection must be substantial enough to prevent the original ground under it from washing through the toe protection blanket, and extend far enough lakeward of the structure to prevent undermining. Check for signs of failure such as lakeward movement of the wall, erosion behind or at the toe, or at the end of the structure.

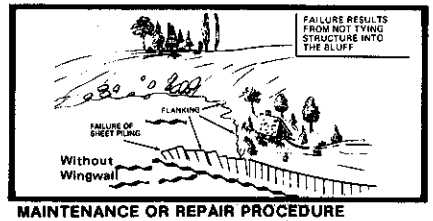


MAINTENANCE OR REPAIR PROCEDURE
Re-establish support by underpinning, tiebacks, systems of anchor piling, walers and tie rod. Place larger stone or rock-filled mattress at toe of structure to prevent scour. Backfill where necessary.

RULE 2
Secure both ends of the shore protection works against flanking

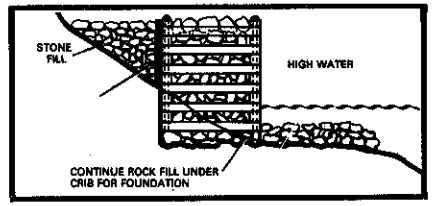


CHECK FOR SIGNS OF FAILURE
Erosion will continue adjacent to your works. If an existing structure has been flanked, such as the one shown to the right, correct it by placing additional material at the ends and tying your works directly into the bluff. Check for signs of failure such as lakeward movement of the ends and erosion at the end of the structure. The illustration to the right shows the result of not constructing wingwalls and tying the ends of the structure into the bluff.

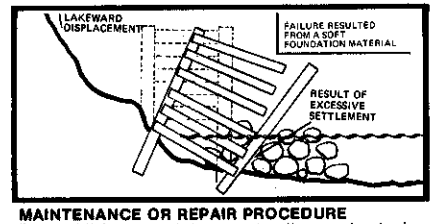


MAINTENANCE OR REPAIR PROCEDURE
Place additional material at the ends and tie structure directly back into the bluff.

RULE 3
Check foundation conditions



CHECK FOR SIGNS OF FAILURE
Soft foundation material may result in excessive settlement of the structure. Soft underlayers may allow all or part of structure to slide. Check for settlement, and excessive displacement. Hydrostatic pressure due to groundwater seepage may cause lakeward movement of some types of impermeable walls.

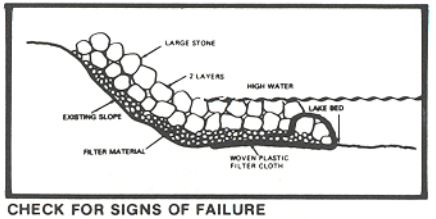


MAINTENANCE OR REPAIR PROCEDURE
Re-establish support by constructing underpinning, foundation protection and backfilling. If the structure was impermeable such as a steel wall add or reopen weep holes.

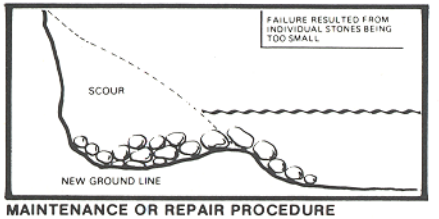
MAINTENANCE GUIDELINES

maintenance requirements are described below. Constant vigilance of all structures is necessary. Inspect your structure after every storm. Repair it immediately if it shows any sign of damage. Except for the alternative of relocation, the various structures shown below are all subject to failure if not built in accordance with construction guidelines. Once built, they must be maintained in accordance with maintenance guidelines.

RULE 4
Use material that is heavy and dense enough that waves will not move individual pieces of the protection

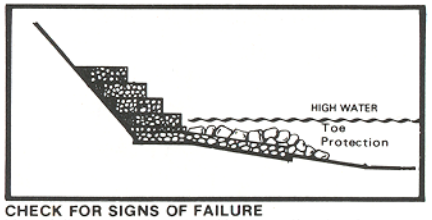


CHECK FOR SIGNS OF FAILURE
A cause of common failure is to use undersized material; waves have tremendous power and can move a lot of material in a short time. Small stones, or pieces of concrete, will be moved around and carried away by small waves. Larger waves will do it even faster. The bank revetment to the right was constructed of undersized stone that was carried down the slope by large waves. Excessive settlement, increase in voids, loss of filter material, erosion behind or at the end of the structure can result due to the use of small stone layer. Filter material may be required between underlying ground and the prospective material.

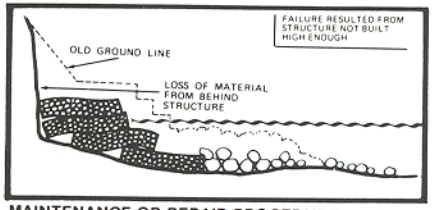


MAINTENANCE OR REPAIR PROCEDURE
Place additional stone at toe, restore to original elevation, location and thickness, reduce excessive void ratio, back fill behind structure; extensive upgrading in size of material may be required.

RULE 5
Build revetment high enough that waves cannot overtop it (spray overtopping is all right, but not "green water")

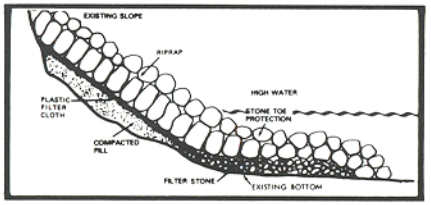


CHECK FOR SIGNS OF FAILURE
Many failures have happened because the structure was not built high enough and erosion could then continue behind the structure as if it were not there. Check for broken wire, excessive movement, and erosion behind or at ends of structure.

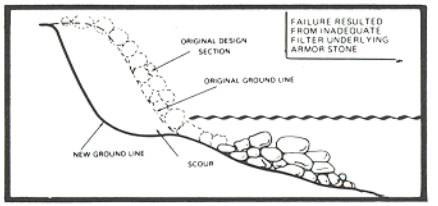


MAINTENANCE OR REPAIR PROCEDURE
Restore to higher elevation, back fill behind structure, add filter cloth, and splash apron.

RULE 6
Make sure that voids between individual pieces of protection material are small enough that underlying material is not washed out by waves



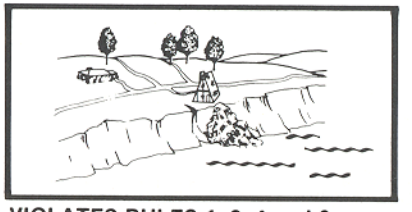
CHECK FOR SIGNS OF FAILURE
A filter material such as plastic filter cloth must be placed on a highly erodible embankment to prevent the fine material from washing through the voids in the structure. The protection material must be thick enough to make a long passage for dissipation of wave energy prior to reaching the underlying materials. In the case to the right plastic filter cloth was not included. As a result fine bluff material was washed out by waves.



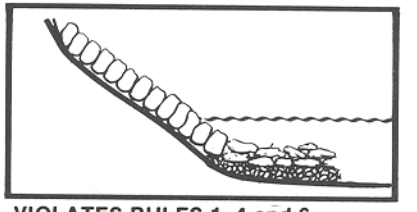
MAINTENANCE OR REPAIR PROCEDURE
Rebuild to original elevation, use at least two layers of stone; use a stone filter or plastic filter cloth; fill behind structure.

IMPROPER SOLUTIONS

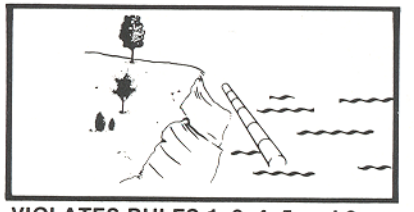
Each of these IMPROPER SOLUTIONS violates two or more construction guidelines. Can you tell which construction guidelines each of these examples violates and how the structures will fail? Answers are provided under each illustration.



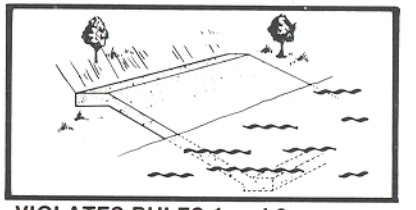
VIOLATES RULES 1, 2, 4 and 6



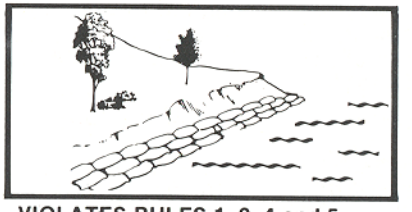
VIOLATES RULES 1, 4 and 6



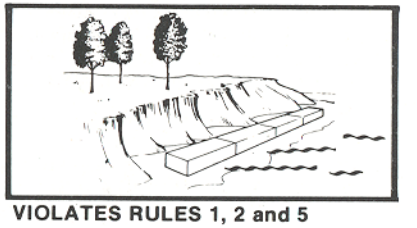
VIOLATES RULES 1, 2, 4, 5 and 6



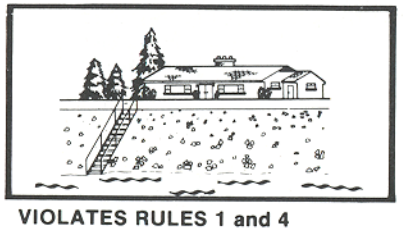
VIOLATES RULES 1 and 2



VIOLATES RULES 1, 2, 4 and 5



VIOLATES RULES 1, 2 and 5



VIOLATES RULES 1 and 4