Ohio Sea Grant

GUIDE TO LAKE ERIE BLUFF STABILIZATION

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PREFACE

The following "self-help" manual has been prepared to provide Lake Erie shore property owners with information and assistance for stabilizing bluffs along the lake which have suffered erosion. The manual provides data and descriptions of alternative structural and non-structural methods for stabilizing the eroded bluffs, including methods for control of surface and ground waters and reshaping of bluff faces, together with detailed methods for planting and maintaining the various alternative types and kinds of vegetation most suitable for best attaining erosion control on the bluff slopes.

The preparation of the material in this manual was originally financed, in part, by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, United States Department of Commerce, under the provisions of the Coastal Zone Management Act of 1972 and, in part, by the State of Illinois Coastal Zone Management Program, Division of Water Resources, Department of Transportation and the Illinois Department of Energy and Natural Resources, State Natural History Survey Division, for use by Lake Michigan shoreline property owners. The Ohio Sea Grant Program is grateful to these organizations for allowing us to modify their document, Harmony with the Lake: Guide to Bluff Stabilization, to suit the needs of Lake Erie shore property owners.

The manual is not intended to be a substitute for those professional engineering and landscaping services that may be needed in specific instances to properly achieve bluff stability and revegetative effectiveness. Property owners are urged to secure such services in those areas particularly complex and beyond the technical capability of the individual property owner.

Charles E. Herdendorf
Director

TABLE OF CONTENTS

EROSION PROCESSES

As shown on the accompanying sketch (Figure 1), erosion can result from storm-induced wave attack upon the toe of the bluffs; from excessive table-land surface water runoff over the bluff; surface runoff on the bluff face itself; ground water slumps; fracturing of slopes resulting in earth slides from too-steep slopes; and last, but not least, lack of vegetative cover, which accelerates the erosion processes listed above. This brochure has been designed to provide the property owner with technical information in order that he can identify which specific problems exist at his particular location and the various alternatives that are possible to minimize the erosional impact of these problems. Since revegetation is an excellent bluff stabilization technique, the uses of vegetation, along with specific methods of application, species diversity, and proper maintenance are highlighted.

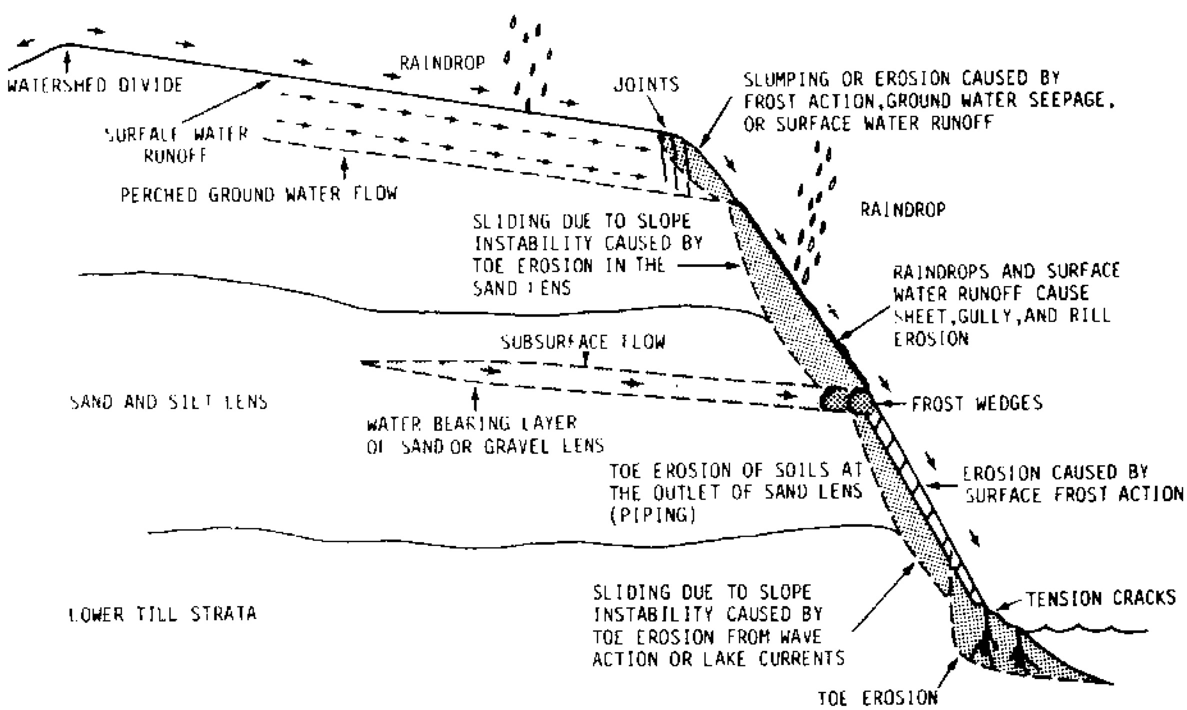

Figure 1: Typical Lake Bluff Erosion Processes

The major cause of severe bluff erosion along the shoreline of Lake Erie is that which is caused by storm-induced wave action impinging upon the toe of the bluffs. This erosion is accelerated greatly when lake levels are high inasmuch as the beaches, which normally serve as protection for the bluffs, become submerged, allowing the wave forces to work directly on the toe of the bluff and dunes. The waves wash away the fine bluff material and either carry it offshore to deep water or move it along the shore by littoral currents.

It is emphasized that it is virtually impossible to control effectively the other types of bluff erosion unless the toe of the bluff has first been protected completely and effectively from continued erosion. To prevent toe erosion, some type of shore protection is needed that will protect the base of the bluff from wave attack. A detailed discussion of alternative methods of shore protection for the toe of the bluff, including design and cost information, is not included as a part of this brochure, but is available in the Army Corps of Engineers' Help Yourself brochure. It can be obtained free of charge by writing to:

Department of the Army
North Central Division
Corps of Engineers
536 South Clark Street
Chicago, Illinois 60605

After protecting the toe of the bluff to control toe erosion, it is strongly suggested that the following additional erosion control measures be taken as necessary in the following order of priority:

1. When necessary, and if possible, reshape the bluff face to a stable angle of slope.
2. Control any excessive surface water runoff.
3. Control any excessive ground water seepage.
4. Revegetate the bluff face as necessary.
5. Initiate and continue regular maintenance of the above listed measures.

Each property owner should inspect his property and then:

1. Determine the cause of erosion at the specific location in question and the elevation of the problem areas relative to the water surface of the lake, or the top of the bluff. Determine the slope of the existing bluff face.
2. Select the types or combination of the types of controls needed to correct the problems at each specific site. Make a detailed plan of operations for installation of the total control system.
3. Install the system starting at the toe of the slope, working to the top of the slope. **Controls in the upper areas of the slope are dependent on the lower control systems.**
4. After installation of the controls, revegetate as necessary.

Relationship of Existing Angle of Bluff Slope to Bluff Stability

In order for a property owner to be able to consider the alternate measures possible for reshaping the bluff face, it is necessary to determine the angle of his particular bluff slope. This can be done by constructing on cardboard a simple slope-angle indicator as outlined in Figure 2. By "eyeing in" the bottom of the cardboard indicator until it is parallel to the slope of the bluff, then reading the angle indicated by the weighted string, the slope of the bluff may be determined. In this manual, slopes of bluffs are referred to in terms of the ratio of horizontal feet to vertical feet rise in the ground. A 1:1 slope is 45°, a 1½:1 slope is 34°, a 2:1 slope is 27°, and a 3:1 slope is 18°.

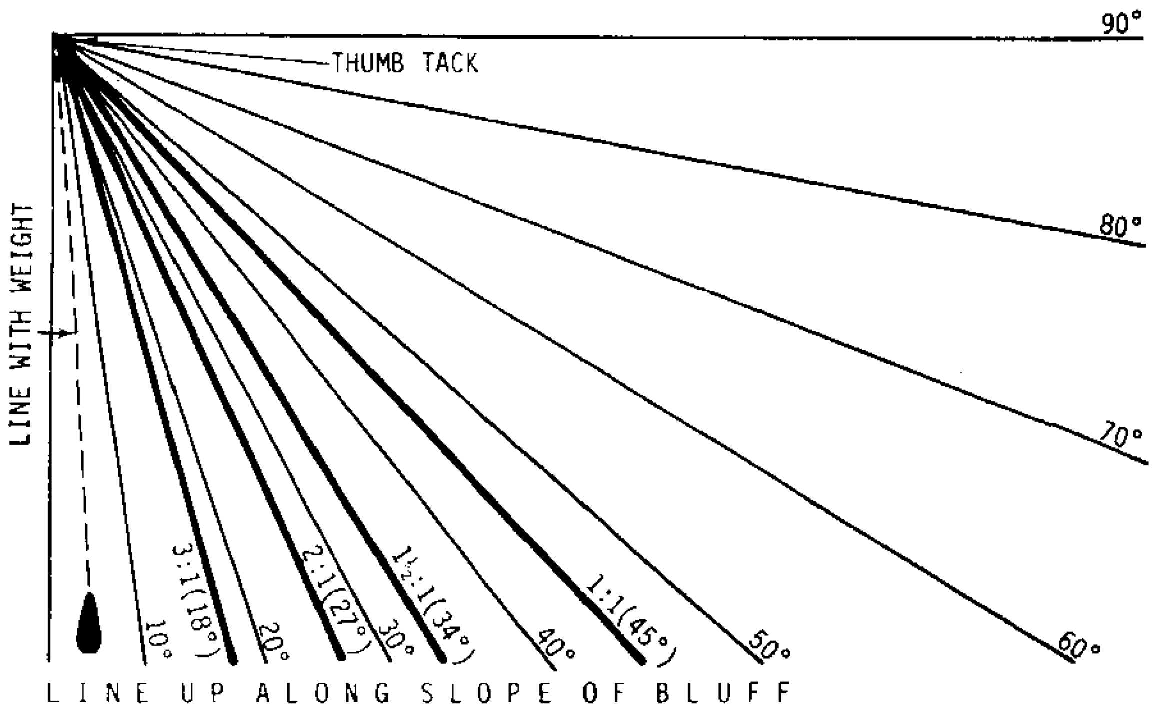

Figure 2: Protractor for Measuring Slope of Bluff

Natural slopes in the area that are not affected by erosion appear to be stable at a 1½:1 slope. Bluff slopes which are steeper than this may be unstable, depending upon the type of soil material within the bluff and the ground water levels. In some high-bluff areas, the slopes are very steep due to erosion and must either be cut back or filled in to a stable slope.

Therefore, it is recommended that, if possible, any bluff slope steeper than 1½:1 be reshaped to at least 1½:1 before erosion control measures (other than toe protection) are undertaken. In the event that reshaping of steeper slopes to a 1½:1 slope is impossible, it is considered that erosion control measures for slopes up to

1:1 may be attempted if the property owner is prepared to rebuild some of the erosion control measures should they fail, including revegetation efforts. **None of the erosion control measures outlined in this brochure can be recommended for any slopes greater than 1:1.**

Relationship of Groundwater to Bluff Stability

The soil that comprises Ohio's Lake Erie bluff is a massive glacial till (gray-colored silty clay with rock inclusions) overlain by lake-deposited sediments (brown-colored silt and fine sand). The glacial till also carries traces and lenses of sand and gravel. Generally, the till provides good foundation support and, when well vegetated and drained, can stand on a stable slope as steep as $^{6}/_{10}$:1. Even when denuded of vegetation, dry till can stand stable at a slope of 1:1. When saturated, bare till is unstable on slopes as low as 2¼:1 and localized upper bluff slumping, massive shear failures, and block slumping often result. Therefore, where ground water problems exist, it is imperative that ground water levels be controlled such that they do not increase the instability of bluff slope faces.

METHODS FOR RESHAPING BLUFFS

Fill Method

This method brings in fill from an outside source and places it on the face of the steep bluff to form a stable slope (Figure 3). The natural bluff will be drained by the placement of plastic filter cloth and gravel, 8-inch perforated collector pipe, and 12-inch outlet pipe installed as described for the cut and fill method. An alternate method of stabilizing the bluff consists of the construction of a series of 6- to 9-foot high retaining walls (cribs or gabions) separated by fill graded to a 3:1 slope. The horizontal distance between the walls should be 21 feet. The fill to be placed to the rear of the lower walls can be used as a working surface from which

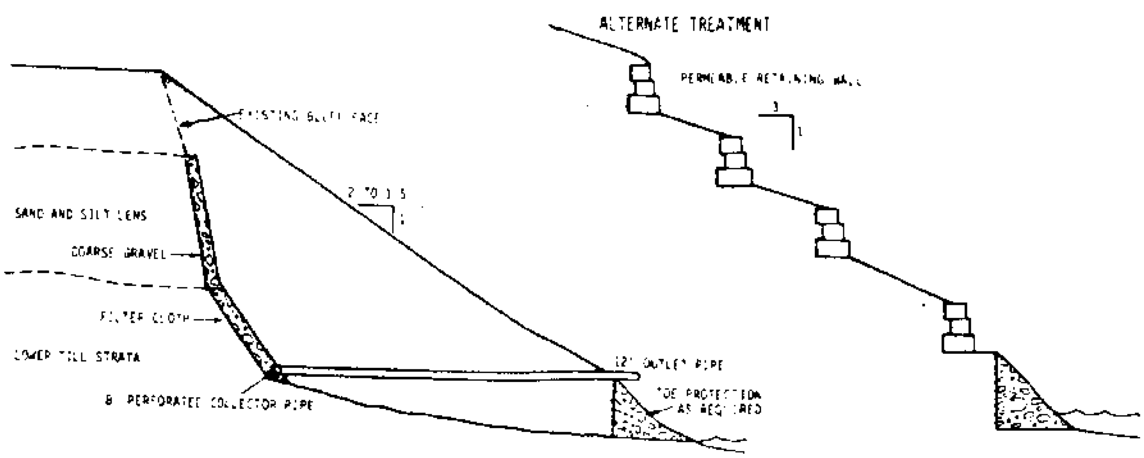

Figure 3: Fill Method of Reshaping Bluff Faces

the next upper wall and section of drainage can be constructed. The areas to be filled can be filled with materials consisting mostly of sand and gravel or crushed rock to provide for drainage through the fill to the drainage system. The surface area may be filled with soil to a depth sufficient to support vegetation. This method is not difficult to construct and will drain the existing slope, stop seeping of ground water, and provide stable, gradually sloping terraces which will resist erosion and support plant life. It is particularly useful for those bluffs whose overall slope is stable, with the exception of the immediate upper bluff area. The estimated first cost for this method may be $1,000 to $1,700 per linear foot if treatment of the entire bluff face is needed. If only upper bluff wood cribbing walls are needed, these will cost some $15 to $45 per linear foot, depending upon the height of the wall.

Advantages: Valuable land will be reclaimed.

Disadvantages: The methods are costly and require a source of fill.

Cut and Fill Method

In this method, fill from the upper portion of an unstable bluff is excavated and compacted in the lower portion (Figure 4). This method drains the natural slope of the lower portion of the bluff (after it has been cleared of vegetation) by placement of a plastic filter cloth against the bluff, followed by placement of a maximum of 4 feet of coarse gravel thereon. The filter cloth and gravel can be placed as the lifts of the fill are added. Groundwater drained from the bluff strata will be transmitted downward through the gravel layer to an 8-inch diameter

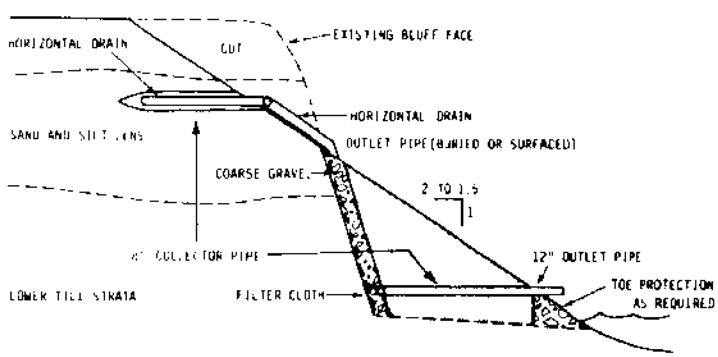

Figure 4: Cut and Fill Method of Reshaping Bluff Faces

perforated drain pipe to be installed parallel to the base of the bluff. Water collected in the perforated pipe will be drained to the lake by 12-inch diameter drain pipes at a slope of approximately 100:1. These outlet pipes, which are perpendicular to the bluff face, can be spaced approximately 400 feet apart. If sand and silt lenses with seepage problems occur above the fill area, a drainage method to control these, such as a horizontal drain system, may be advisable. The collection pipe for these drains may be connected to the collector pipe located at the base of the bluff. Care in compaction is a necessary engineering concern. The amount of compaction per lift and thickness of each lift of soil depends on the type of soil used for the fill. The estimated first cost for this method is approximately $350 per linear foot.

Advantages: The fill material can be obtained within the immediate area of concern.

Disadvantages: Some valuable tableland will be lost.

Cut Only Method

This method of bluff stabilization consists of excavating an unstable slope to a recommended slope of 1½:1 (Figure 5). Any seepage zones may be eliminated by a dewatering system. In this case, perforated horizontal drains are recommended. Water collected in the perforated drains should be carried to an 8-inch collector pipe to the bluff face. The water should then be carried down to the toe of the bluff through outlet pipes which can be either buried or carried on the surface. The estimated first cost of this method is approximately $600 per linear foot.

Advantages: This method provides a large amount of soil which can be sold or used elsewhere on the property.

Disadvantages: A large amount of valuable tableland will be lost. If the excavated soil cannot be sold or used, it will be expensive to dispose of.

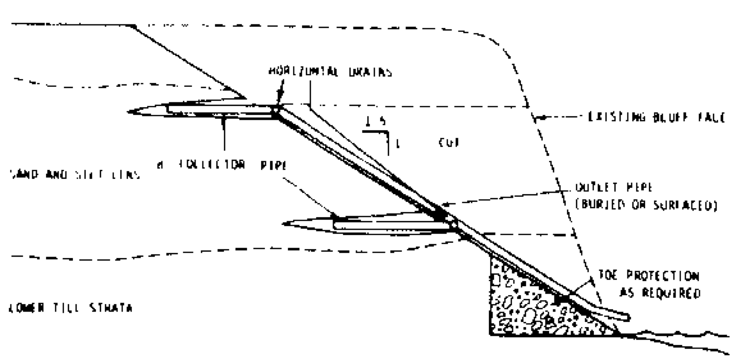

Figure 5: Cut Only Method for Reshaping Bluff Faces

Vertical Well Systems

A vertical well system often is used for improving groundwater conditions (Figure 6). It generally is designed to pump water up the well to the surface. Collector pipes, outlet pipes, or paved ditches should be provided to remove the water to a location where it can be discharged without danger of re-entering the slope and causing further instability. Some well systems can provide bypassing of impervious layers of soil by allowing seepage to drain vertically downward into pervious sand/gravel at the base of the well system.

Horizontal Drain Systems

A horizontal drain system is a small-diameter well that is drilled nearly horizontally into the bluff and cased with perforated pipe to allow groundwater seepage to drain to the face of the bluff (Figure 6). Collector pipes and outlet pipes or paved ditches usually must be provided. In most horizontal drains, installation of the initial drains serves as exploratory boring to locate areas where additional drains should be drilled. Finished installations often have drains spaced across the face of the bluff at intervals from 20 to 50 feet. When access to a suitable drilling location is difficult, several drains usually are fanned out from the most suitable locations. The length usually varies from about 50 up to 300 feet. To determine the actual spacing of each well or drain is a lengthy and complicated process. If a substrata or sand lens drainage system is necessary, it is recommended that a professional soils engineer design the type, amount, spacing, and location of the system to be used.

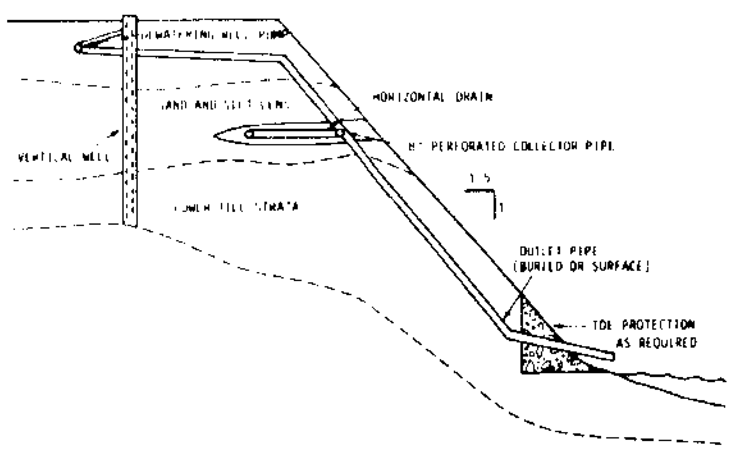

Figure 6: Vertical Well and Horizontal Drain Systems for Groundwater Control

CONTROL OF DRAINAGE FROM TOP OF BLUFFS

The land areas along the top of Lake Erie Bluffs (tablelands) naturally slope gently toward the lake. Unless controlled, surface storm water runoff, during periods of high-intensity rainfall, flows over the top of the bluff and down the face of the bluff slope causing erosion of the bluff face and loss of bluff soil and vegetation.

The predominant natural soil on the top of the bluff is marly silt loam, extending to a depth of 2 to 3 feet. Underlying the loam is a 1- to 2-foot layer of relatively impermeable silty clay. During periods of extended heavy rainfall or extensive lawn watering, surface water, in addition to flowing over the top of the bluff, penetrates the silt loam to the top of the clay layer and creates a saturated condition in the soil. This groundwater (called the perched water table) moves laterally toward the lake and outlets on the face of the bluff, creating a wet and unstable condition at the points of outlet. Such seepage, together with the surface flow, if continuing over a period of time, can lead to slumping at the top of the bluff. In addition, the wet-ground condition increases the difficulty of establishing and maintaining vegetative cover on the bluff face.

Figure 7 shows a typical water control system which can be employed along the top of a bluff to control surface and perched groundwater discharges at the

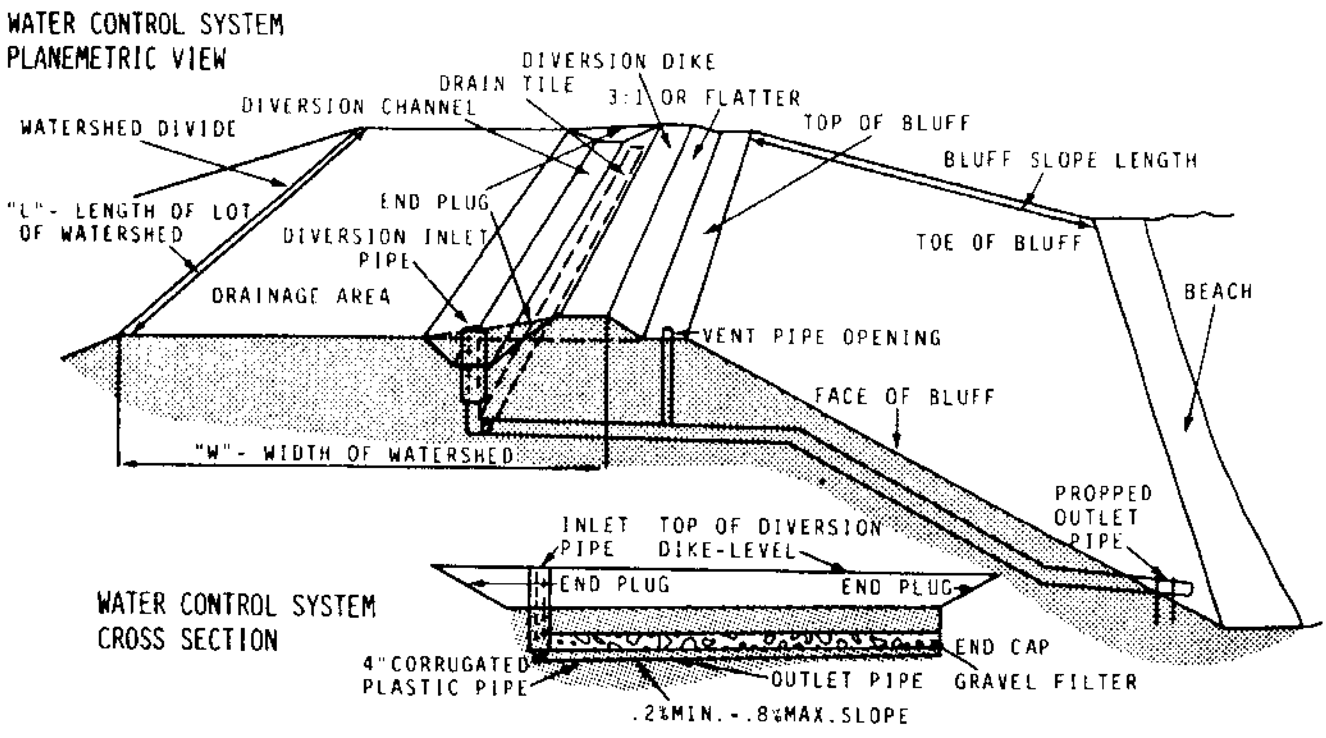

Figure 7: Water Control System for Top of Lake Bluffs

upper face of the bluff. The system is designed to control excess surface water from a 10-year frequency, 24-hour duration storm. Inasmuch as soil types, depths of soils, ground slopes, etc., may vary from area to area, it is suggested that each riparian owner seek professional advice before initiating construction of such a system on his property.

The system involves development of a surface water retention area (diversion channel) along the top of the bluff to intercept and temporarily hold surface water runoff, together with development of an outlet pipe to carry the stored runoff down the face of the bluff to the lake. In addition, development of an underground tile system along the face of the bluff is necessary to intercept the perched ground water flow. This underground tile system discharges into the same outlet needed for the diversion channel.

TYPICAL DESIGN OF A DIVERSION CHANNEL

The drainage system described above involves construction of a surface water retention area or diversion channel along the top of the lake bluff. The following section outlines the steps necessary to construct a diversion channel (Figure 8):

Step 1: Determine dimensions of watershed. From field reconnaissance determine length (L) and width (W) of watershed. The watershed divide is that line along the land surface at which the surface water starts to flow toward the lake.

Step 2: Determine size of drainage area in acres. Using length (L) and width (W), enter Table 1 and determine area of watershed in acres. If watershed is not approximately rectangular in shape, compute the drainage area by some other method.

Step 3: Determine the required diversion bottom width. Using width (W), enter Table 2 and select the required diversion bottom width. Note that the diversion channel averages 2 feet in depth and has a 4:1 or flatter side slope. The top of the diversion dike must be level throughout its length. Although the figure shows the diversion channel to be trapezoidal in cross section, the sides and bottom may be rounded, shaped, and modified and the alignment may be varied to be more aesthetically pleasing to the property owner. In making such modifications, keep in mind the required 2-foot depth and minimum bottom width from Table 2.

Step 4: Select the required size of diversion channel outlet pipe. Using the drainage area determined in step 2, enter Table 3 and select required outlet pipe size for the pipe material to be used. If the pipe outlet is to be buried in the bluff face, polyvinyl chloride pipe, corrugated plastic tubing, or corrugated metal pipe may be used. Do not use corrugated plastic tubing if the outlet pipe is to be placed on the surface of the bluff face inasmuch as the tubing will deteriorate rather rapidly when exposed to direct sunlight.

Smooth polyvinyl chloride pipe should be 1120 or 1220 Schedule 40 or SDA-26 in 10-foot lengths with rubber gasket flexible joints. Corrugated metal pipe should be 16-gauge helical galvanized pipe with watertight coupling bands. Corrugated plastic tubing should be heavy duty.

If polyvinyl chloride or corrugated metal pipe is used on the surface of the slope, the pipe sections should be fastened with holding straps to anchors at 10-foot intervals as shown in the accompanying figure. The holding straps should be located below the bell at each polyvinyl chloride pipe joint. The holding straps should be tight so that the pipe will not slide downhill in the straps. The holding straps and anchors should be fastened at the sides of the pipe to allow the pipe freedom of up-and-down movement due to frost action in the soil beneath the pipe. Pipe buried in the slope whould be below the frostline.

Step 5: Determine the required size of diversion inlet pipe and orifice plate. Using the required outlet pipe size and desired pipe material, enter Table 4 and determine the required inlet pipe size and orifice plate diameter. The inlet pipe shall be slotted smooth polyvinyl chloride pipe and larger in diameter than the outlet pipe in order to ensure that the design volume of water can reach the outlet pipe under all conditions. Do not omit the orifice plate as it is necessary to restrict the volume of water flowing to the outlet pipe in order that the outlet pipe does not flow full under high pressures. High pressure pipe flow can cause leakage or rupture of the pipe, pipe joints, and seams. The orifice plate should be of galvanized steel or ¼-inch acrylic plastic with all cuts smooth and sharp-cornered.

When corrugated plastic tubing or corrugated metal pipe is used as an outlet pipe, it should be extended into the bell of the PVC reducing tee. The area between the pipe and the tee or elbow should be caulked with fibrated asphalt.

Step 6: Supporting the outlet end of the outlet pipe. The outlet end of the outlet pipe should be supported as detailed in the accompanying figure. The supported outlet should be located where lake wave action or currents will not cause damage to the supports or pipe. The outlet should be so placed that its discharges either fall upon existing rip-rap or other bluff-toe erosion protective measures or suitable measures must be made to prevent erosion of the ground at the outlet.

Step 7: Estimated installation costs. Many factors affect the cost of excavating a diversion channel, but a rough figure of $1.50 per linear foot of length of the diversion (L) can be used to find an approximate cost. Tile drains may be estimated at a cost of $1.25 per linear foot. Table 5 may be used to estimate the cost of a 4-inch corrugated plastic tubing diversion outlet pipe buried in the bluff face. These costs include a $3 per foot cost for burial of the outlet.

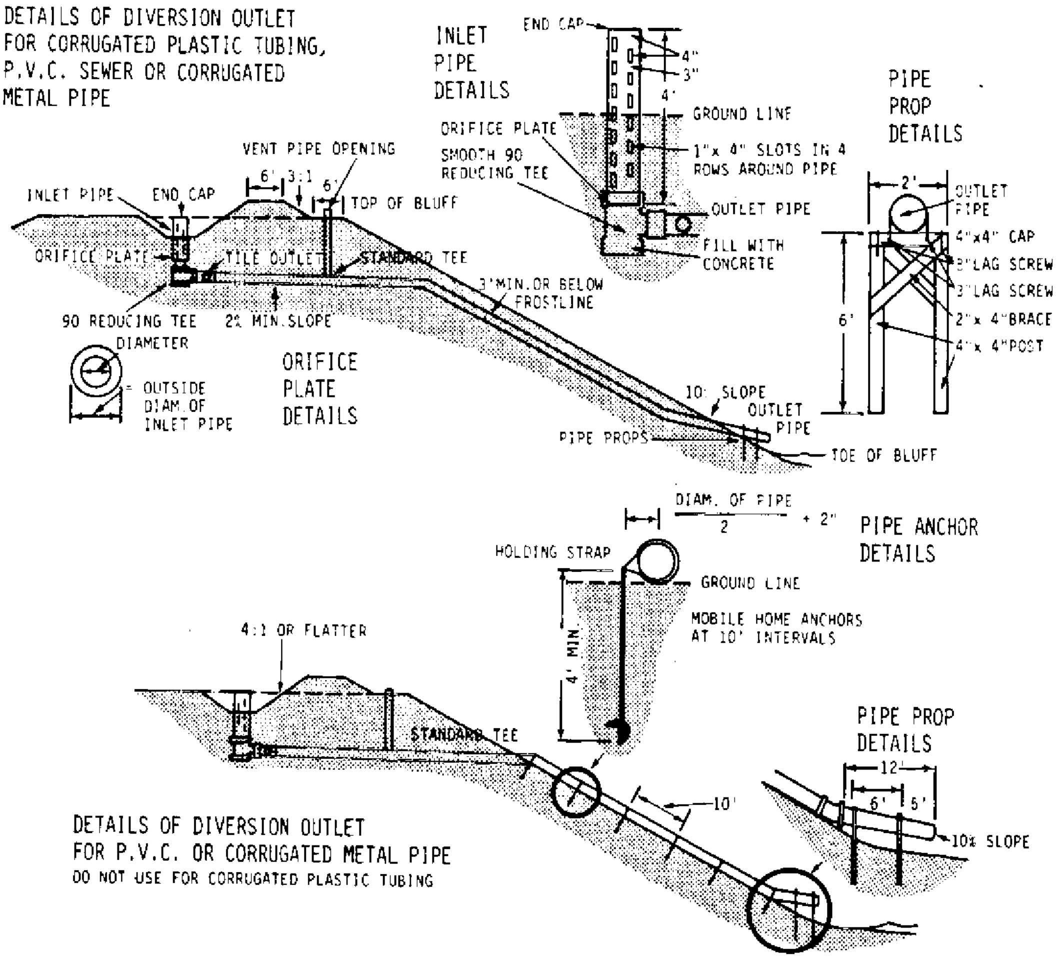

Figure 8: Details of Diversion Outlet Designs

TABLE 1. Determination of area of watershed in acres from length (L) and width (W) measurements in feet.

	(W)					
(L)	100	200	300	400	500	550
100	0.23	0.46	0.69	0.92	1.15	1.26
200	0.46	0.92	1.38	1.84	2.30	2.52
300	0.69	1.38	2.07	2.75	3.44	3.79
400	0.92	1.84	2.75	3.67	4.59	5.05
500	1.15	2.30	3.44	4.59	5.74	6.31
550	1.26	2.53	3.79	5.05	6.31	6.94

TABLE 2. Determination of diversion channel bottom width in feet from width (W) of the drainage area in feet.

(W)	Bottom Width of Channel
200	0
300	2
350	4
400	6
450	8
500	10
550	10

TABLE 3. Required diversion outlet pipe diameters in inches for different sizes of drainage areas in acres for polyvinyl chloride pipe, corrugated plastic tubing, and corrugated metal pipe.

Outlet Size	Polyvinyl Chloride	Plastic Tubing	Corrugated Metal
4 inches	0.0 to 1.7 acres	0.0 to 0.7 acres	Not Available
5 inches	Not Available	0.7 to 1.8 acres	Not Available
6 inches	1.7 to 4.1 acres	1.8 to 2.9 acres	0.0 to 1.7 acres
8 inches	4.1 to 7.0 acres	2.9 to 7.0 acres	1.7 to 3.8 acres
10 inches			3.8 to 7.0 acres

TABLE 4. Required polyvinyl chloride pipe inlet dimensions and orifice diameters for different outlet pipe sizes and materials (all sizes are diameters in inches).

	Diversion Pipe Outlet Data					
Outlet Pipe	Corrugated Plastic Tubing Outlet		PVC Plastic Pipe Outlet		Corrugated Metal Pipe Outlet	
	Inlet Pipe	Orifice	Inlet Pipe	Orifice	Inlet Pipe	Orifice
4	6	2.00	6	2.50	-	-
5	6	2.75	-	-	-	-
6	8	3.50	8	4.25	8	3.00
8	10	5.00	10	6.00	10	4.50
10	-	-	-	-	12	5.75

TABLE 5. Cost of a 4-inch polyvinyl chloride pipe diversion outlet with pipe laid on the face of the slope.

Length of Slope (feet)	Base Cost of Diversion Outlet (per foot length of slope)
30	$10.20
40	8.40
50	7.08
60	6.60
70	6.00
80	5.70
90	5.40
100	5.10
110	4.80
120	4.62
130	4.44
140	4.32
150	4.20

For pipes buried in the slope, add $3.00 per foot length of slope to the total cost of the diversion outlet.

TABLE 5, continued

Multipliers to allow for larger pipe sizes and alternate materials:

Corrugated plastic tubing:	4-inch diameter, times 0.83
	5-inch diameter, times 0.88
	6-inch diameter, times 0.96
	8-inch diameter, times 1.13
Polyvinyl chloride pipe:	6-inch diameter, times 1.17
	8-inch diameter, times 1.50
Corrugated metal pipe:	6-inch diameter, times 1.50
	8-inch diameter, times 1.75
	10-inch diameter, times 1.92

USE OF VEGETATION IN BLUFF STABILIZATION

General Considerations

Vegetation is a very important part of an erosion control program for the slopes, both from functional and aesthetic points of view. It must be emphasized that vegetation alone is of little value against direct wave action and slumping of the bluff crest. Before initiating a vegetation-establishment program, make sure the toe and crest of the slope are stable. Suggestions for correcting these problems are given in this manual.

Compared to most structural means of controlling erosion, the cost of establishing a vegetative cover is quite inexpensive. However, more will be needed than a few pounds of grass seed and a sack of fertilizer, and when budgeting for a total erosion control program, be sure to include an adequate amount for vegetation. Certain procedures must be followed, and it is the purpose of this brochure to give guidelines that will allow the riparian owner to successfully establish vegetation on suitable slopes. While it is advisable, and often necessary, to get professional advice, the property owner often can do much of the work involved in planting.

The presence or absence of vegetation is a good indicator of the stability of a slope. There will be a good growth of plants on slopes that are less than 1½:1 when the slopes are not subject to direct wave action or excessive ground water seepage. The lack of vegetation on these less-steep slopes indicates that some type of active erosion is occurring. Slopes steeper than 1:1 usually have no vegetation since the soil is not stable at such steep angles.

The type of vegetation that can be established on a slope is very much dependent on the angle of the slope. If the angle is steeper than 1:1, the soil will be unstable and the possibility of establishing a vegetative cover is slight. On slopes flatter than 3:1, it is possible to use lawn mowers, which makes a mowed lawn feasible. On slopes between 1:1 and 3:1, vegetation will grow, and, although it is not possible to establish a mowed lawn on such slopes, there are a number of possibilities that a property owner may choose from.

How Plants Control Bluff Erosion

A good vegetative cover is very effective in controlling certain types of erosion. The above-ground portions of plants shield soil from the direct impact of rain drops, and herbaceous plants, especially grasses, retard rapid runoff of rainfall and filter out small soil particles. The root systems of plants reinforce the soil, hold soil particles in place, and can penetrate unstable soil layers. By the process of transpiration, water is carried from the roots to the leaves where it passes out into the air; this reduces soil moisture and can contribute to soil stability (Figure 9).

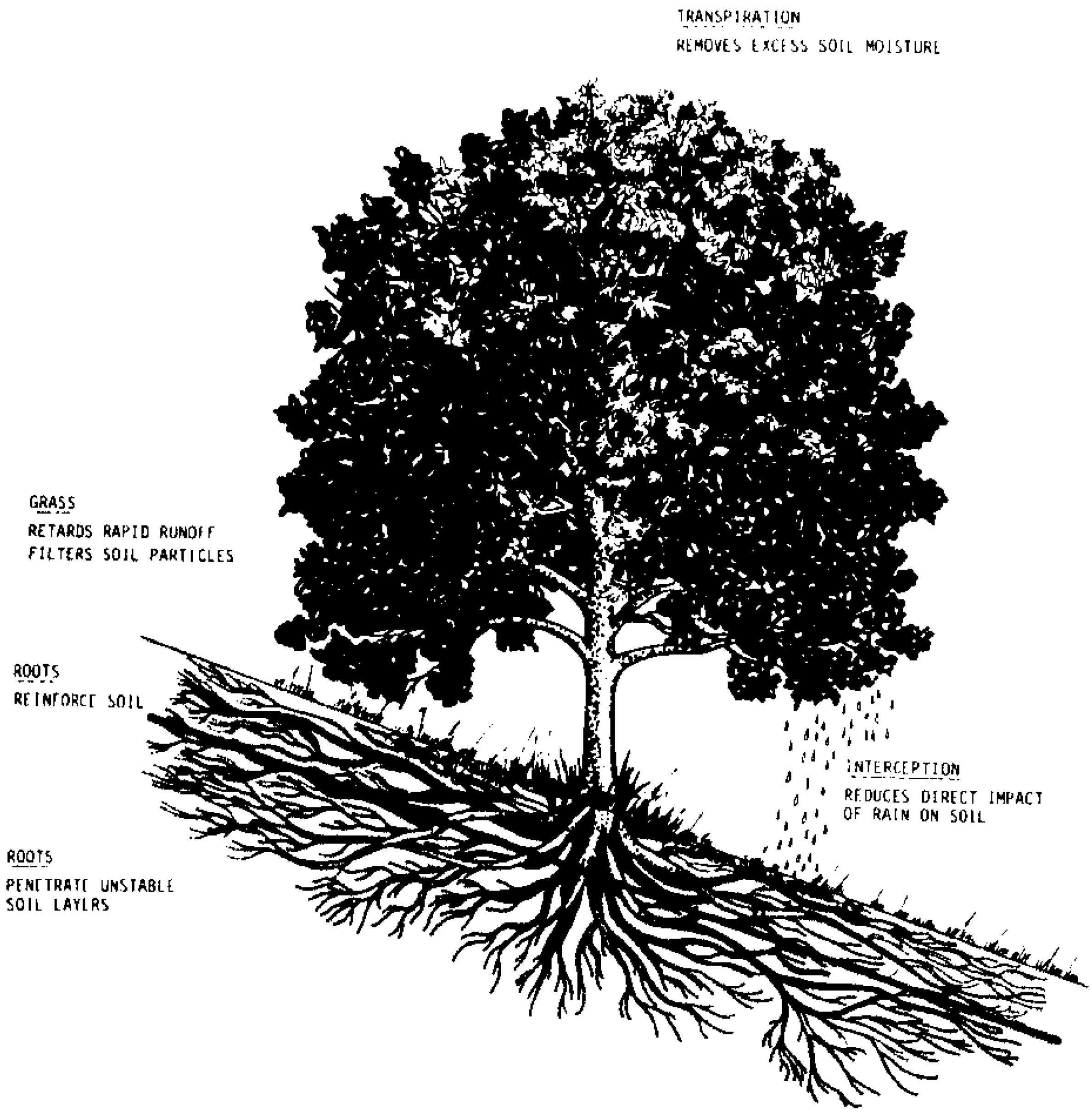

Figure 9: How Plants Control Bluff Erosion

For purposes of erosion control, plants can be grouped into three categories: herbaceous plants (including grasses and ground covers), shrubs, and trees. Each of these categories has certain erosion control qualities, as summarized in Table 6. Note that the depth to which a root system penetrates determines the amount of stability the roots add to the soil and the amount of deep soil moisture that is removed.

TABLE 6. Erosion Control Qualities of Herbaceous Plants, Shrubs and Trees

	Herbs	Shrubs	Trees
Interception of Rainfall	Good	Good	Good
Retardation of Runoff	Good	Poor	Poor
Filtering of Surface Soil Particles	Good	Poor	Poor
Depth of Penetration of Root System*	VS-M	S-M	S-D

*VS=Very Shallow; S=Shallow, M=Moderate, and D=Deep

Planning Considerations for Vegetation Planting

When planning a program to establish vegetation on the slopes, take the following points into consideration.

Slope stability. Is the slope presently stable or will it be when planting of new vegetation begins? If not, see the reverse side of this brochure.

Climate. The climate of the Ohio coastal zone is moderated by the large water mass of Lake Erie and both the spring and autumn seasons are extended. This effect is quite local. This "lake effect" should be taken into account when planning for vegetation stabilization.

Existing vegetation. Make a survey of the slope to determine the extent and health of any plants presently on the slope. Note particularly any that are healthy and worth preserving. If a wooded area is present, **do not** clear-cut all the trees to get a better view of the lake. Often there are patches of bare soil on slopes that otherwise have a good vegetative cover. Use the plants and procedures given below to get a new vegetation on the bare areas.

Selective thinning and topping. A dense, heavily wooded slope is very effective in controlling erosion. However, such a woods often blocks the view of the lake. Selective pruning, topping, and removal of certain trees can open up the view and, at the same time, allow the remaining trees and shrubs to receive more sunlight. Thinning should be done gradually, with the removal of a few unwanted branches or trees each year. Leave the brush and shrubs undisturbed. **Under no circumstances cut down or top all the trees on a slope at one time.**

Aesthetics. One of the principle reasons for living along Lake Erie is, of course, to have a view of the lake. Vegetation largely determines the overall effect and breadth of the vista. As shown in the accompanying sketch, the vegetation on a bluff is seen from a number of viewpoints, such as from across a lawn above the bluff, looking downward from the edge of the bluff, from the beach and lake, and from adjacent properties. Different kinds of plants have different aesthetic qualities. Size, shape, color, and texture contribute to the total visual impression of a plant. When initiating a vegetation program, try to combine form and function so that a plant cover is established that is effective against erosion while at the same time meets your visual desires.