CHAPTER 4 - SHORELINE PROTECTION STUDY AND PLAN

I. SHORELINE PROTECTION STUDY

Lancaster County is a coastal community that has, as previously stated, approximately 330 miles of tidal shoreline. The environment created by this interaction between the land and water along the County's coasts has helped to form our community's identity. Residents who want to live in a scenic setting, citizens who come to the water for recreation, and watermen who earn a living off the rich resources found here value this area of land and water. The importance of shoreline areas to Lancaster County's citizens for their shoreline is reflected in their desire and actions to protect these areas.

However, action of people to protect the natural shoreline can disrupt an existing delicate balance. Understanding this balance can help decision makers and property owners make the most informed and best possible decisions concerning the protection of the shoreline. This is the goal of the Lancaster County Shoreline Protection Study and Plan.

The Lancaster County Shoreline Protection Study and Plan addresses the issues and policies concerning shoreline erosion protection and control measures. It investigates the existing shoreline condition and makes recommendations based on those findings. The plan will attempt to balance all the factors present when considering shoreline erosion; the natural forces of erosion, the present shoreline condition, the type of water body, and the property owner.

The first key in understanding Lancaster County's shoreline situation is to determine how much of the shoreline is eroding and where these sections of shoreline are located. After areas of erosion are determined, the reasons for erosion must be determined. Lastly, property owners' responses to erosion problems, such as alteration of their shoreline, have to be investigated as to their effectiveness and the impact of their efforts.

A. EROSION RATES

The Virginia Institute of Marine Science has created three different categories to group shoreline erosion. The first group is Slight/None, which describes shoreline that is eroding at a rate of less than 1 foot per year. The second group is Moderate, which is shoreline that is eroding at the rate of 1 to 3 feet per year. The third group is Severe, which is shoreline that is eroding at a rate of 3 or more feet per year. Lastly, to suit the needs of the County's Plan, an additional category -- Accretional -- has been added to describe shoreline area that is actually building or increasing over time.

The 2001 Lancaster County Shoreline Situation Report completed by the Virginia Institute of Marine Science grouped the County's waterfront parcels into categories based on their shoreline situation. The results are detailed below:

Slight/None	83%

Moderate	11%
Severe	5%
Accretional	2%

This same report also divides the County into four segments. Highest erosion is in Segment 1 that includes Bay shoreline with rates ranging from 1.6 to 7.9 feet per year. Erosion in remaining segments ranges from 0.0 to 5.1 feet per year. In the 100-year period prior to the first Shoreline Situation Report, 792 acres had eroded from the 43 miles of Bay Shore and 561 acres from the 125 miles of river shore.

B. EROSION FACTORS

1. Fetch and Water Body Energy

The distance wind and waves travel across open water before they reach land is called the "fetch." For example the fetch across the Chesapeake Bay is over 20 miles in the parts of Lancaster County along the Bay. The fetch across most tidal creeks in Lancaster County ranges from a few hundred feet in the upper reaches to ½ to 1 mile near the creeks' mouths. The fetch is important because it is a major factor in the amount of energy a water body generates. The greater the fetch, the greater the amount of wave energy and the greater the potential for erosion.

Low Energy Water Bodies
This category includes the inland part of all the tidal creeks, coves, and upper reaches of rivers in Lancaster County including the following:

Indian Creek
Dymer Creek
Tabbs Creek
Antipoison Creek
Oyster Creek
Mosquito Creek
Carter Creek
Taylor Creek
Upper Western Branch
Myer Creek
Whitehouse Creek
Greenvale Creek
Deep Creek
Mulberry Creek
Lancaster Creek
Upper Eastern Branch
Moran Creek

Medium Energy Water Bodies

Main Branch Corrotoman River
Mouths of Tidal Creeks along Main Branch of Corrotoman River
Little Bay
Rappahannock River above Towles Point
Mouths of Tidal Creeks along Rappahannock River above Towles Point

High Energy Water Bodies

Mouth of the Corrotoman River
Rappahannock River Below Towles Point
Mouths of Tidal Creeks along Rappahannock River Below Towles Point
Fleets Bay
Chesapeake Bay
Mouths of Tidal Creeks along Chesapeake Bay

2. Boat Traffic and Wake

Wakes caused from boat traffic can greatly worsen erosion on adjacent shoreline. Effects of boat wakes are generally greater in narrow water bodies where the resulting wake has less area to dissipate before it reaches the shoreline and in areas where there is a large amount of boat traffic. Generally, wakes tend to dissipate over larger distances such as major rivers and bays. However, in narrow stretches of water the shoreline usually absorbs the impact of the boat wake.

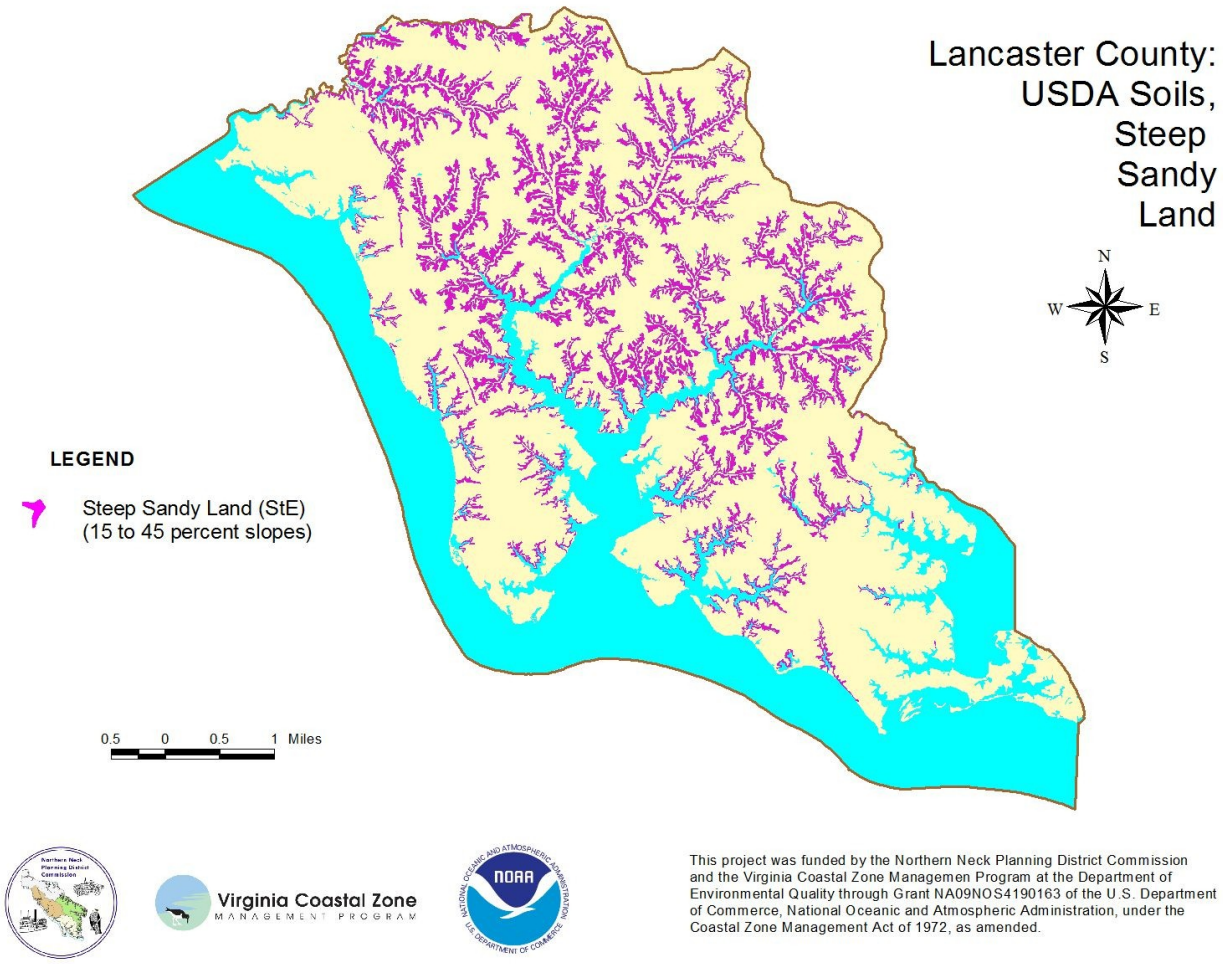
Heavy boating areas in Lancaster County include Carters Creek, the Rappahannock River, the main branch of the Corrotoman River, Fleets Bay, and the Chesapeake Bay. Medium areas of boating activity include Myer Creek, Lancaster Creek, Greenvale Creek, Whitehouse Creek, Indian Creek, Dymer Creek, Tabbs Creek, and Antipoison Creek.

3. Existing Shoreline Condition

a. Topography and Soil Type

The topography of the shoreline plays a large role in how the shoreline erodes. Large shoreline bluffs adjacent to the water can be threatened by wave scour at their base and seepage of groundwater along their faces. The base of the bluff is weakened and soil that is saturated with groundwater collapses downward and "sloughs off." This trend will continue until the bluff's base is protected and the face is stabilized.

Steep areas along many upper reaches of Lancaster County's tidal water and shoreline are stable only until they are disturbed by development. These areas, which can be difficult to re-stabilize, tend to be present where there is the existence of steep land and sandy soils. Sandy soil types are found throughout Lancaster County and make up approximately 28% of the county's soil. These soils are generally found along natural drainage courses along upper or inland reaches of tidal creeks and smaller tidal rivers as depicted on the following map:



This project was funded by the Northern Neck Planning District Commission and the Virginia Coastal Zone Managemen Program at the Department of Environmental Quality through Grant NA09NOS4190163 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

b. Natural Protection

Existing vegetation along the shoreline can act to stabilize erosion of the shoreline. Additionally, wetlands adjacent to the shoreline can act as a buffer or baffle that can protect the shoreline. Barrier island beaches and sand spits can also act to absorb wave energy before it reaches the shoreline of the mainland. Lastly, Submerged Aquatic Vegetation can act to slow and dissipate wave energy before it reaches the shore.

c. Man-made Protection

Altered shoreline can act to prevent erosion at the point where the shoreline is altered. However, the alteration of the shoreline in one location usually acts to increase erosion in areas down drift of the altered shoreline area. Natural erosion of land results in sediment loss that acts to nourish down drift shoreline. When a shoreline is altered, this natural supply of nourishment is lost.

C. SHORELINE ALTERATION

Shoreline is altered by the construction of erosion protection structures on, adjacent to, or abutting the shoreline. These artificial stabilization structures include bulkheads, revetments, breakwaters, groins, and jetties.

Alteration of the shoreline can have positive and negative impacts. Positive impacts are the stabilization of severely eroding land, protection of endangered structures, and the protection of surface water quality. Negative impacts include possible down drift erosion, loss of wetlands, and a disruption of natural shoreline processes. Negative impacts are often magnified as the amount of altered shoreline rises. Increased alteration can also result in a further loss of natural balance in the shoreline environment.

In 1978, 14 miles or 73,920 feet (5%) of shoreline was artificially stabilized in Lancaster County. The 1994 Lancaster County Shoreline Inventory completed by the Northern Neck Planning District Commission showed that 28.7 miles or 151,620 feet of shoreline had been artificially stabilized by 1993. By 2006, 73.12 miles of shoreline (22.1% of the total) had been stabilized. As of December 2011, 437,243 feet or 82.8 miles of shoreline (25.1% of the total) had been stabilized. While the trends for shoreline stabilization using almost exclusively hard methods accelerated in the last ten years, there is an indication that more property owners are turning to green or "soft" solutions for shoreline protection where appropriate as knowledge and commercial availability of these solutions has increased.

High areas of artificially stabilized shoreline in Lancaster County include:

1. Morattico
2. Monaskon
3. Main Branch Corrotoman
4. Mouth of Corrotoman/Weems
5. Carter Creek
6. Palmers/Brightwater
7. Windmill Point and Marina Area
8. Norris Bridge area

Source: Lancaster County Shoreline Situation Report, Virginia Institute of Marine Science, Gloucester Point, VA, June 2001.

D. TYPES OF SHORELINE PROTECTION

1. Dunes

Dunes are a natural form of shoreline protection. They are basically a ridge or mound of loose, wind-blown material, such as sand. Dunes are very effective when vegetated.

However, dunes must be protected from foot and vehicular traffic. In Lancaster County, there are several isolated areas of sand dunes, all of which are on private property. The larger areas of dunes in Lancaster County are generally found along the lower Rappahannock River and the Chesapeake Bay, including parts of Fleets Island and Deep Hole Point. Smaller dune areas are found scattered throughout the County and are usually adjacent to higher energy water bodies.

Access to dune areas in Lancaster County is through private property or state-owned waters. Therefore, vehicular traffic is very limited with access available only to property owners with dunes on their land. However, pedestrian access to dune areas is not as limited; both individual property owners and boaters generate traffic. Realistic methods of minimizing negative impacts of pedestrian traffic in dune areas, which also recognize the Chesapeake Bay Preservation Act's allowances for access to state waters, need to be further explored in Lancaster County. Possible protection methods could include the requiring of raised walkways over dunes and other environmentally sensitive features when considering future development.

2. Vegetation (Fringe Marsh Establishment)

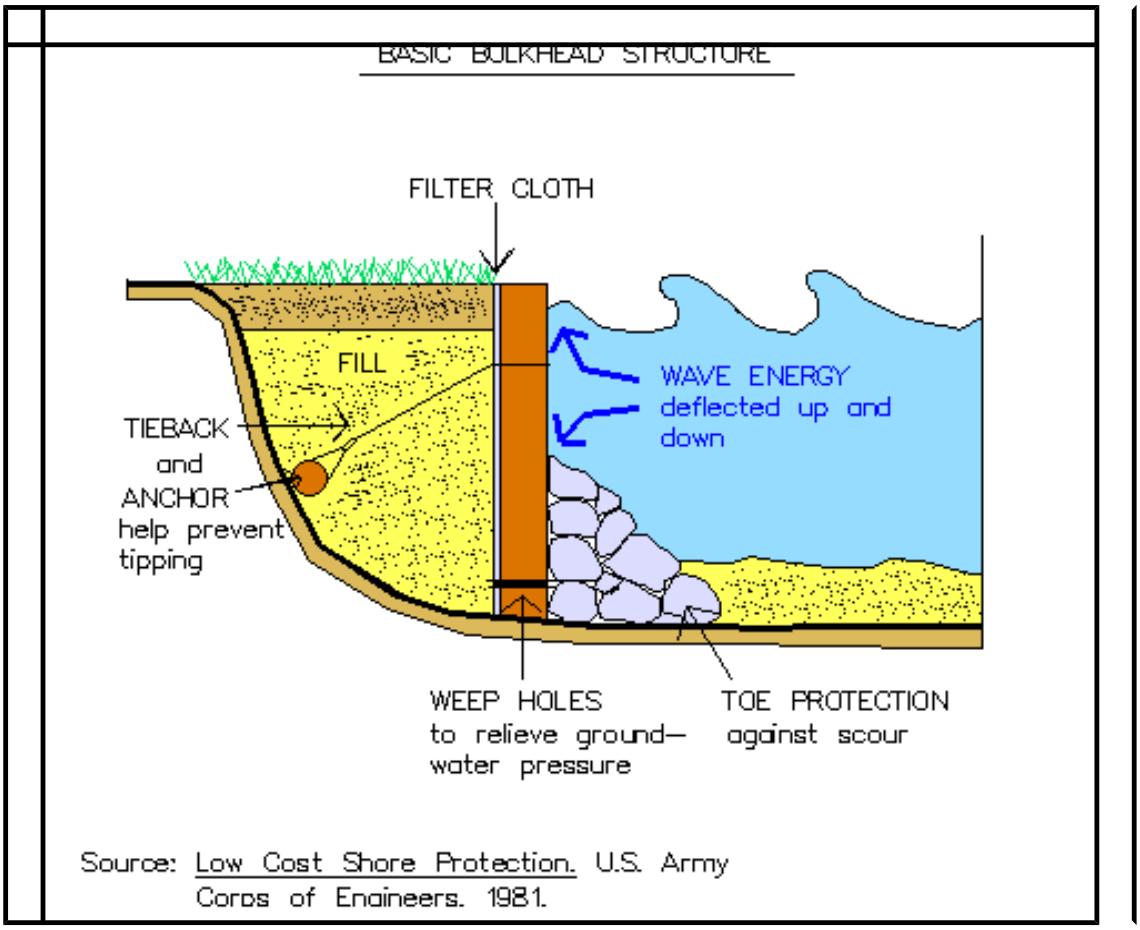
Vegetative shoreline protection is usually limited to creeks, smaller rivers, coves and partially protected shorelines where there are smaller fetches, and therefore less wave energy. Fringe marsh establishment is an environmentally sound shoreline protection alternative that is far less expensive than other commonly used methods for shoreline erosion protection and often requires no permits.

Many shoreline areas in Lancaster County are ideal for fringe marsh establishment. Often, previous fringe marsh in these areas has died due to boat wakes, the long-term effects of wave action, and the blocking of sunlight by large overhanging trees. The result is that a bank starts to erode where vegetative buffer existed before. Establishment of a new marsh fringe can reverse this erosion situation.

Fringe marshes have many desirable impacts. First, an established marsh traps sand moving with the tide and helps maintain a suitable marsh elevation. Additionally, fringe marsh acts as a baffle, which diminishes wave energy in the vegetated area before it reaches and erodes the upland bank. Fringe marshes also act to enhance water quality and wildlife habitat. Finally, fringe marsh is by far the most inexpensive method of shoreline protection.

3. Bulkheads and Seawalls

Bulkheads and seawalls protect banks and bluffs by completely separating the land from the water. Bulkheads act as retaining walls keeping the earth or sand behind them from crumbling or slumping. Seawalls are primarily used to resist wave action. Construction of bulkheads and seawalls can act to hasten erosion of beach areas immediately in front of the structures. This is because the structures redirect wave energy downward to the toe and beach areas. Bulkheads and seawalls are most appropriate where fishing and boating are the primary uses of the shore. They would not be appropriate on gently sloping beach areas.



4. Breakwaters

Breakwaters are structures placed offshore to diminish the energy of incoming waves. Larger breakwaters are suitable for protection of deep harbors. Individual property owners can use much smaller breakwaters to protect their shoreline. Breakwaters in this category are usually one to three hundred feet offshore in relatively shallow water and are designed to protect a gently sloping beach. Additionally, after wave energy is dissipated, sandy drift material can then be deposited behind the breakwater and act to build up the beach or protected shoreline.

Breakwaters must be properly designed. If they are too high they can interfere with natural shoreline processes, and if they are too low the shoreline will be inadequately protected. Breakwaters are also prone to scour, so the toe of the structure must be protected. Lastly, breakwaters can have negative impacts on neighboring or down shore properties. Drift material trapped by breakwater can stop renourishment of down shore shoreline.

5. Groins

Groins are structures that extend, finger-like, perpendicularly from the shore. Groins are usually constructed in groups called fields. The primary purpose of a groin is to trap and retain sand, nourishing the beach compartments between them. Groins are designed to interrupt the long shore transport of littoral drift. They are more effective where long shore drift is predominantly in one direction. If not properly placed, groins can decrease nourishment of downdrift shore, resulting in erosion of that shore.

Groins are suitable erosion control measures where a beach is desirable, and they are compatible with most recreational activities. Sand trapped by groins eventually provides a buffer between incoming waves and backshore and inland areas. The waves break on the new beach and expend most of their energy there. Groins are effective protection during normal weather conditions but offer only limited protection against storm-driven waves.

6. Revetments

Revetments are structures placed on banks or bluffs in such a way as to absorb the energy of incoming waves. The most common type of revetment used in Lancaster County is the rip-rap. Revetments are usually constructed to preserve the existing use of the shoreline and to protect the slope. Like seawalls, revetments armor and protect the land behind them. Additionally, depending on construction materials, revetments can be either watertight or porous. Porous revetments are most desirable because they can act to further diminish wave energy, while allowing less wave energy to be reflected off of the structure's surface to beach or marsh areas in front of the structure.

Most revetments do not act to interfere with transport of littoral drift. Furthermore, they do not act to redirect wave energy to unprotected areas, except for beaches immediately in front of the structure. However, protecting previously eroding land cuts off the supply of the eroding material that before acted to nourish down shore beaches. This causes downshore beaches to have less nourishment and can result in their eventual erosion.

Revetments must be built with armor material sufficient enough to withstand storm conditions prevalent in the area being hardened. Undersized armor rocks or material will cause the revetment to fail. The toe or base of the revetment should be buried or protected to prevent scouring of the structure. Revetments also should be built on gentle slopes with 2 to 4 feet of run for every foot of rise. Lastly, failure to tie the revetment structure back into the shoreline can result in flank erosion around the structure, because the flank area now receives no up shore nourishment from the protected shoreline.

E. EXISTING CONDITION OF LANCASTER COUNTY SHORELINE

For purposes of study, the Virginia Institute of Marine Science (VIMS) 2001 Lancaster County Shoreline Report groups shoreline into geographic segments. There are four segments that can be broken down into twenty-six plates, the number being determined by the size and shape of the County. Data is presented in the Shoreline Situation Report by

plate and segment. A summarization of shoreline characteristics by segment is as follows:

Segment One

Description: Extends from border with Northumberland County south through Fleets Bay and east to Windmill Point
Shoreline Described: 93.64 miles
Land Use: 41% forested, 34% residential, 25% all other uses including nine commercial operations

Segment Two

Description: From just west of Windmill Point, covering the Rappahannock River past Mosquito Point, the Route 3 Bridge, Carter Creek and the surrounding town of Irvington
Shoreline Described: 61.51 miles
Land Use: 38% forested, 16% "scrub/shrub", 36% residential, 5% commercial, 5% all other uses

Segment Three

Description: Corrotoman River System
Shoreline Described: 113 miles
Land Use: 59% forested, 31% residential, 9% agricultural, 1% commercial

Segment Four

Description: Rappahannock River northwest from mouth of Corrotoman River to Richmond County line
Shoreline Described: 62.49 miles
Land Use: 56% forested, 11 % "scrub/shrub", 24% residential, 9% all other uses but primarily agriculture

Those interested in the complete Shoreline Situation Report may find it by accessing the following website:

http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/lancaster/lancaster_disclaimer.htm

In 2012, VIMS also completed a Shoreline Evolution Report for Lancaster County's shoreline. This report uses aerial photos taken between 1937 and 2009 to determine the rates and patterns of shoreline change. The images were used to digitize shorelines and rates of change were calculated in 10-meter increments and plotted on maps. Two hardcopies of the report are located in the Planning and Land Use Office for public reference. The report is also available online at:

http://web.vims.edu/physical/research/shoreline/Publications-Evolution.htm

Shorelines can also change over time as a result of flooding associated with tropical storms or hurricanes. The Federal Emergency Management Agency (FEMA) has created and periodically updates Flood Insurance Rate Maps (FIRMs) for Lancaster County which determine the various flood zones along the county's shoreline. Hardcopies of the FIRMS are located in the Planning and Land Use Office for public reference and they are also available online at: http://msc.fema.gov. Flood zones are depicted on the county's geographic information system and may be accessed by visiting the county website at: www.lancova.com. A storm surge inundation map for the various hurricane categories is also available at: http://www.lancova.com/emserv/VirginiaStormSurge_Lancaster.png

II. ASSESSMENT OF EXISTING CONDITIONS

Lancaster County is fortunate to have a large amount of tidal shoreline and related natural resources. As the previous section documented, the majority of the shoreline is still described by forests. However, as the shoreline becomes more developed, proper management of this resource will be required to preserve the present attractive qualities. The first part in the management process is recognizing the natural dynamics that shape the County's shoreline. The second part in this process is to understand how man's actions can positively or negatively impact these resources. Lastly, proper management requires balancing the natural shoreline processes with man's interaction in order to reach the goal of a protected, but enhanced environment.

Several areas of Lancaster County have historically experienced severe shoreline erosion including areas along Fleets Island, Fleets Bay, Morattico, and the Main Branch of the Corrotoman River. Also several areas of the County have historically been impacted by moderate shoreline erosion including much of the shoreline along the Rappahannock River and the Main Branch of the Corrotoman River. There are many reasons for this shoreline erosion including the fetch and energy of the particular body of water, the topography and condition of the existing shoreline, the previous alteration of the shoreline, and wakes caused by boats.

While necessary in high wave energy areas, the cumulative impact of shoreline hardening in Lancaster County should be a cause for concern. The result of further alteration of the County's shoreline could be a continued loss of shoreline wildlife habitat, a non-uniform shoreline with spotty and unpredictable patterns of erosion and an increase in the loss of wetlands and beach areas.

As a separate but related consideration, Lancaster County has a limited system of non-intermittent and intermittent streams that feed tributary waters. Because of the topography of Lancaster County, erosion along the banks of these streams is virtually nonexistent. All streams have less than two feet of drop from their source to the point they enter tributary waters. As a result, under normal flow conditions, there is no opportunity for water to gain velocity that could cut banks. In periods of high rain where much greater levels of flow occur, the increased flow tends to spread over heavily vegetated stream basins, dissipating

velocity while creating little or no erosion in the basin or on the banks. The fact that the highest point in Lancaster County is no more than 100' in elevation above adjacent streambeds is significant. There is therefore little opportunity for stormwater to gain velocity as it runs off land adjoining streams. Finally, most development in Lancaster County is concentrated around tidal waters.

III. SHORELINE PROTECTION PLAN

A. EQUAL SITE SITUATION

Individual property owners must review all shoreline protection alternatives and select the protection method most suitable for their shoreline. In many cases protection methods such as fringe marsh establishment are more economically and environmentally suitable solutions for shoreline protection, particularly in the many creeks in Lancaster County.

The over-armoring of the shoreline is costly environmentally and economically. Bulkheads and rip-rap can result in a loss of wetlands and beach areas due to scouring at the base, and wave energy reflected off the body of these structures. Hardening of the shoreline can cause down drift erosion due to the loss of nourishment supplies that have now been cut off through alteration, and of the protection structures themselves. Finally, the property owner loses because they chose an expensive protection means when an alternative, cheaper method would have been sufficient.

Where hardening of the shoreline is necessary, County staff and the Wetlands Board must encourage those methods that have the least impact on the environment. For example, this policy would encourage the use of properly designed porous revetments such as rip-rap over impenetrable means such as concrete revetments and bulkheads. Porous revetment structure can act to dissipate the wave's energy as the wave breaks up the structure. Impenetrable structures instead act to deflect wave energy up, down, and back out, which can result in loss of sensitive environmental features in front of the structure.

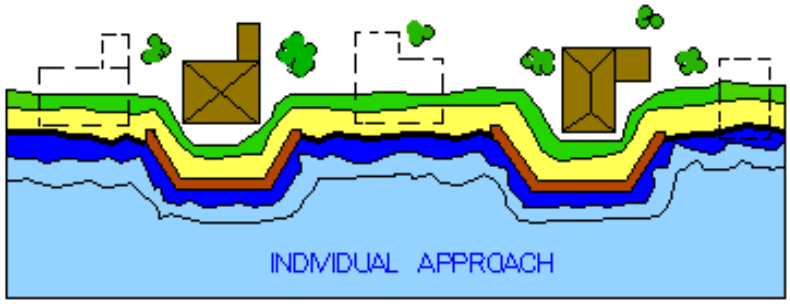
B. INCENTIVES FOR SUBDIVISION WIDE SHORELINE PROTECTION EFFORTS IN PROPOSED SUBDIVISIONS

The Lancaster County Subdivision Ordinance requires a shoreline management plan for new waterfront subdivisions to provide subdivision-wide shoreline protection efforts vice individual efforts. This requirement assures that unique on-site characteristics related to

shoreline protection would be studied and addressed in a coordinated, subdivision-wide manner. It also gives the County a chance to influence the shoreline protection efforts of a larger area at one time before they become the many separate, individual efforts of property owners in a new subdivision.

C. COOPERATIVE APPROACHES TO SHORELINE PROTECTION

Cooperative approach to shoreline protection results in more effective protection against erosion, enhanced safety for personal property, an increased number of desirable building sites, and cost savings due to shared expenses.



Individual approach to shoreline protection results in possible increased erosion risk to neighboring properties due to flanking of the bulkheads, a decrease in the number of desirable building sites, and a disjointed, uneven shoreline.

Source: Low Cost Shore Protection. U.S. Army Corps of Engineers, 1981.

Cooperative protection efforts in existing subdivisions benefit both the County and waterfront property owners. First, the county gains through the preservation or enhancement of waterfront land values that in turn support the tax base. Secondly, property owners benefit by sharing construction costs perhaps reduced by the economies of scale, while ensuring that flanking properties as well as their own are protected. The result is that the County is left with a more attractive, uniform shoreline, a constant or increased tax base, and citizens who have saved through shared shoreline protection costs.

D. ENCOURAGE VEGETATIVE ALTERNATIVES FOR SHORELINE PROTECTION AND VEGETATIVE ENHANCEMENT OF RESOURCE PROTECTION AREAS

Vegetative methods of shoreline protection are effectively used in parts of Lancaster County, including areas along tidal creeks, coves, and other low-energy water bodies with smaller fetches. Fringe marsh establishment, selective trimming of branches overhanging existing shoreline vegetation, landscaping, and enhancement of existing vegetation are options available to property owners in applicable shoreline areas. Additionally, all waterfront property owners could undertake vegetative enhancement of Resource Protection Areas.

Such efforts include the planting of vegetative buffer areas or the replenishment and enhancement of existing shoreline vegetation. The benefits are that the property owner saves money through not opting for bulkheads or rip-rap, the shoreline is left in a natural state, and wildlife habitat is enhanced.

E. SUPPORT EFFORTS TO EDUCATE PROPERTY OWNERS CONCERNING SHORELINE PROTECTION ISSUES AND ALTERNATIVES

Lancaster County will continue supporting programs for educating waterfront property owners about shoreline protection. The more knowledgeable property owners are of issues and alternatives surrounding shoreline protection, the better prepared they will be to decide upon their shoreline protection methods. The County will work with the Northern Neck Planning District Commission in re-instituting a workshop specifically for waterfront property owners considering shoreline protection strategies that will include identifying sources of plant materials appropriate for such protection.

Shoreline protection is regulated under the Lancaster County Code of Ordinances Chapter 26, Article II "Coastal Primary Sand Dune Regulations" and Article III "Wetlands". The County also employs an Environmental Codes Compliance Officer who serves as the staff contact to the Wetlands Board and should be the first point of contact for citizens with shoreline protection questions.

IV. GOALS AND OBJECTIVES

GOAL #1: **Actively encourage shoreline protection measures that are equal to the erosion potential at a particular site.**

Objective: Encourage alternative shoreline protection methods such as fringe marsh establishment in shoreline areas with less wave energy, light boat traffic, and small fetches.

Objective: Discourage use of bulkheads and riprap in low energy, lightly traveled water bodies, unless erosion justifies shoreline hardening for protection purposes.

Objective: Encourage use of revetments instead of bulkheads in high-energy shoreline zones, while also ensuring that revetment structures are armored adequately enough to provide the intended protection.

GOAL #2: **Encourage vegetative enhancement of Resource Protection Area (RPA) sections**

Objective: Evaluate subdivision proposals as to their existing shoreline condition and upland characteristics in regard to erosion. If necessary, recommend RPA enhancements to offset impacts of proposed development.

Objective: Encourage individual property owners to maintain and enhance their RPA areas in ways that protect the existing shoreline, improve water quality, and mitigate the impact of their development.

GOAL # 3: **Encourage coordinated shoreline protection efforts in existing waterfront communities and in new subdivisions.**

Objective: Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.

GLOSSARY OF TERMS

Accretion - The natural building up of sedimentary material along a given segment of shoreline. Areas of accretion are gaining land over time due to natural processes.

Fetch - The unobstructed distance over water in which waves are generated by wind of relatively constant direction and speed. Classifications are as follows:

a. Narrow
b. Moderate
c. Wide
d. Unlimited

Littoral Drift - Sedimentary material moving along the shoreline under the influence of waves and currents.

Nourishment - The process of replenishing a beach. It may be brought about naturally, by accretion due to the long shore transport, or artificially, by the deposition of dredged materials.

Scour - Removal of underwater material by waves and currents, especially at the base or toe of a shoreline structure.

Shore forms

a. Cliffs — A high, steep face of rock; a precipice.
b. Bluffs — A high, steep bank composed of erodible materials.
c. Marshes — Areas of soft, wet or periodically submerged land which is generally treeless and usually characterized by grasses and other low vegetation.
d. Beaches — The zone of sedimentary material that extends landward from the low water line to the place where there is marked change in material or form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach - unless otherwise specified - is the mean low water line. A beach includes the foreshore and backshore.