Dorchester County, Maryland
Shoreline Situation Report
Methods and Guidelines

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Chapter 1. Introduction

1.1 Background

The Shoreline Situation Reports are a desktop reference designed to assist with management and planning of tidal shorelines.   They provide extensive data pertaining to waterfront condition and use . The reports target state and local government officials responsible for structuring activities along the shore. This includes local planners developing comprehensive plans for waterfront development and conservation, managers evaluating status and trends in shoreline condition, and environmental protection agents who regulate or monitor activities along the shore.   The data applications are numerous.

Methods and approaches applied in the classification system are derived from a parallel effort in Virginia (Berman and Hershner, 1999). Both are directed by the Comprehensive Coastal Inventory Program (CCI), a GIS and remote sensing program within the Center for Coastal Resources Management at the Virginia Institute of Marine Sciences (VIMS). This Shoreline Situation Report series for Maryland extends coverage of shoreline condition from Virginia through Maryland. Therefore the project assists to complete a shoreline evaluation along the entire tidal portion of the Chesapeake Bay following a single classification system. This has enormous value for comparing trends in riparian land use and condition throughout the Bay.

Shoreline Situation Reports are generated on a county by county basis. The data and documentation are provided electronically. This report documents the classification protocol and includes methods used to collect and process data. Also available are final maps, GIS data, summary tables and metadata for each locality.   The digital GIS coverages, along with all reports, tables, and maps are available on the web at www.vims.edu/ccrm/gis/gisdata.html under Dorchester County Shoreline Situation Report.

1.2 Description of the Locality

Dorchester County is situated on Maryland's Eastern Shore. It is the largest county in Maryland with a land area of more than 550 square miles.. USGS Digital Line Graph (DLG) data indicate the county has nearly 1,970 miles of shoreline and an additional 773 miles of streams. Most of this shoreline comprise the complex network of tidal channels that wind through extensive marsh complexes forming the Blackwater Wildlife Refuge and the Fishing Bay Wildlife Management Area.

The Nanticoke River forms the southern boundary of the county, sharing the waterway with Wicomico County. Upriver the Nanticoke becomes Sussex County in Delaware on both sides. The centerline of the Choptank River forms the northern limit of Dorchester County. This lower extent of the river is shared with Talbot County immediately to the north. The county shares a border with Caroline county upriver and to the northwest.

The Choptank and the Nanticoke are the largest rivers in the county. However, the Honga, and the Little Choptank are also significant tributaries. There is significant shoreline contiguous to the Chesapeake Bay including Fishing Bay to the south, Trippe Bay to the north, and the long stretch between the entrances of the Honga and Little Choptank Rivers.

For this inventory all navigable waterways were surveyed in the county. Exceptions include the large wildlife management areas mentioned above and other large pristine marsh complexes experiencing very little or no development.

Siting statistics from the Maryland Office of Planning in 1992, the Dorchester County Comprehensive Plan reports forests dominate land use/land cover in the county (41%). Agricultural practices account for 30% of the land area, and wetlands comprise a significant 25% (Dorchester County Comprehensive Plan, 1996). Developed lands account for approximately 3% of the land cover. Projected estimates for growth are relatively low.

The county's most recent comprehensive plan was adopted in 1996 (Dorchester County Planning Commission, 1996). The plan recognizes several important considerations for future development. First, supporting stewardship of the Chesapeake Bay and its tributaries is noted. Approaximately 50% of the county lies within the designated Chesapeake Bay Critical Area. Protection for sensitive areas encourages standards to reduce nutrient and sediment input to the bay. The plan also calls for the use of conservation easements to minimize impacts to sensitive zones. Development within the Critical Area Designations should be limited to low intensity residential development

In response to Resolution 13 passed by the Maryland General Assembly in 1999, the Shore Erosion Task Force in their 2000 report recommended the development of Comprehensive Shore Erosion Control Plans. The state is now assisting localities in developing a coastal hazards framework by providing data and tools to improve their decision making capacity. Dorchester County was one of two localities identified to pilot the development of the shoreline assessment tool. This tool, combined with and complimentary to data included in this inventory prepares the county for targeting and assessing shoreline vulnerability.

1.3 Purpose and Goals

This shoreline inventory compiles field data collected along tidal shoreline in Dorchester County between March and August, 2003. Conditions are reported for three zones within the immediate riparian river area: riparian land use, bank and natural buffers, shoreline. A series of maps and tabular data are published digitally to illustrate and quantify results of this extensive shoreline survey. Major tributaries discharging into the Chesapeake Bay, Nanticoke River, Choptank River, Honga River, and the Little Choptank were surveyed. Ultimately, access and navigability determined the extent of the survey. Large areas of Fishing Bay were surveyed using remote sensing techniques.

1.4 Report Organization

This report is divided into several sections. Chapter 2 describes methods used to develop this inventory, and includes conditions and attributes considered in the survey. Chapter 3 identifies potential applications for the data, with a focus on current management issues. Chapter 4 precedes the digital maps, tables, GIS coverages, and metadata available on the web at http://ccrm.vims.edu/gis/gisdata.html under Shoreline Situation Reports (MD).

1.5 Acknowledgments

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Chapter 2. The Shoreline Assessment: Approach and Considerations

2.1 Introduction

The Comprehensive Coastal Inventory Program (CCI) has developed a set of protocols for describing shoreline conditions along tidal shoreline. The assessment approach uses state of the art Global Positioning Systems (GPS), and Geographic Information Systems (GIS) to collect, analyze, and display shoreline conditions. These protocols and techniques have been developed over several years, incorporating suggestions and data needs conveyed by state agency and local government professionals.

Three separate activities embody the development of a Shoreline Situation Report: data collection, data processing and analysis, and map generation. Data collection follows a three tiered shoreline assessment approach described below.

2.2 Three Tiered Shoreline Assessment

The data inventory developed for the Shoreline Situation Report is based on a three-tiered shoreline assessment approach. This assessment characterizes conditions in the shorezone, extending from a narrow portion of the riparian zone seaward to the shoreline. This assessment approach was developed to integrate observations that could be made from a moving boat. To that end, the survey is a collection of descriptive measurements that characterize conditions. Due to the level of detail this inventory seeks to capture, in situ measurements were required. GPS units log location of conditions observed from a boat. No other field measurements are performed.

The three tiered shoreline assessment approach divides the shorezone into three regions: 1) the **immediate riparian zone**, evaluated for land use; 2) the **bank**, evaluated for height, stability, cover, and natural protection; and 3) the **shoreline**, describing the presence of shoreline structures for shore protection and recreational purposes. Each tier is described in detail below.

2.2a. Riparian Land Use: Land use adjacent to the bank is classified into one of ten categories (Table 1). The categories provide a simple assessment of land use, and give rise to land management practices that can be anticipated. GPS is used to measure the linear extent along shore where the practice is observed. The width of this zone is not measured. Riparian forest buffers are considered the primary land use if the buffer width equals or exceeds 30 feet. This width is calculated from digital imagery as part of the quality control in data processing.

Table 1. Tier One - Riparian Land Use Classes

Forest	stands greater than 18 feet / width greater than 30 feet
Scrub-shrub	stands less than 18 feet
Grass	includes grass fields, and pasture land
Agriculture	includes cropland
Residential	includes single or multi family dwellings
Commercial	includes small and moderate business operations, recreational facilities
Industrial	includes large industry and manufacturing operations
Bare	lot cleared to bare soil
Timbered	clear-cuts
Paved	areas where roads or parking areas are adjacent to the shore
Unknown	land use undetectable from the vessel

2.2b. Bank Condition: The bank extends off the fastland, and serves as an interface between the upland and the shore. It is a source of sediment and nutrient fluxes from the fastland, and bears many of the upland soil characteristics that determine water quality in receiving waters. Bank stability is important for several reasons. The bank protects the upland from wave energy during storm activity. The faster the bank erodes, the sooner the upland will be at risk. Bank erosion can contribute high sediment loads to receiving waters. Stability of the bank depends on several factors: height, slope, sediment composition and characteristics, vegetative cover, and the presence of buffers to absorb energy impact to the bank itself.

The bank assessment in this inventory addresses four major bank characteristics: bank height, bank cover, bank stability, and the presence of natural buffers at the bank toe (Table 2).

Conditions are recorded continuously using GPS as the boat moves along the shoreline. The GPS log reflects any changes in conditions observed.

Bank height is described as a range, measured from the toe of the bank to the top. Bank cover assesses percent of either vegetative or structural cover in place on the bank face. Natural vegetation as well as rip rap are considered as “cover”, and no distinction is made between the two. The assessment is qualitative (Table 2). Bank stability characterizes the condition of the bank face. Banks that have exposed root systems, down vegetation, or exhibit slumping of material qualify as a “high erosion”. Banks that are undercut at the base are classified as “undercut”. At the toe of the bank, a natural buffer of either marsh vegetation and/or beach material may be present. These features offer protection to the bank and enhance water quality. A qualitative assessment of the natural buffer condition is made if present (low erosion/high erosion). Depending on time of tide during the survey, it is sometime difficult to assess the true condition.

Phragmites australis is an invasive wetland species known to out-compete native marsh vegetation. The distribution and spread of the plant has generated concern among wetland ecologists and coastal managers. Various eradication techniques have been employed to control the spread. The distribution of this species along the shore is surveyed as a linear feature. Table 8 (on the website) quantifies this distribution.

2.2c. Shoreline Features: Features added to the shoreline by property owners are recorded as a combination of points or lines. These features include defense structures constructed to protect the shoreline from erosion; offense structures designed to accumulate sand in longshore transport; and recreational structures built to enhance recreational use of the water. The location of these features along the shore are surveyed with a GPS unit. Linear features are surveyed without stopping the boat. Structures such as docks and boat ramps are point features, and a static ten-second GPS observation is collected. Table 3 summarizes shoreline features surveyed. Linear features are denoted with an “L” and point features are denoted by a “P.” The glossary describes these features, and their functional utility along a shore.

Table 2. Tier 2 - Bank Conditions

Bank Attribute	Range	Description
bank height	0-5 ft	from the toe to the edge of the fastland
	5-10 ft	from the toe to the edge of the fastland
	10-30ft	from the toe to the edge of the fastland
	> 30 ft	from the toe to the edge of the fastland
bank stability	low erosion	minimal erosion on bank face or toe
	high erosion	includes slumping, scarps, exposed roots
bank cover	bare	<25% cover; vegetation or structural cover
	partial	25-75% cover; vegetation or structural
	total	>75% cover; vegetation or structural
marsh buffer	no	no marsh vegetation along the bank toe
	yes	fringe or pocket marsh present at bank toe
marsh stability (if present)	low erosion	no obvious signs of erosion
	high erosion	marsh edge is eroding or vegetation loss
beach buffer	no	no sand beach present
	yes	sand beach present
beach stability (if present)	low erosion	accreting beach
	high erosion	eroding beach or non emergent at low tide
Phragmites australis	yes	present
	no	absent

Table 3. Tier 3 - Shoreline Features

Feature	Feature Type	Comments
<u>Control Structures</u>		
riprap	L	
bulkhead	L	
breakwaters	L	first and last of a series is surveyed
groinfield	L	first and last of a series is surveyed
jetty	P	
miscellaneous	L	can include tires, rubble, tubes, etc.
<u>Recreational Structures</u>		
pier/wharf	P	includes private and public
boat ramp	P	distinguishes private vs. public landings
boat house	P	all covered structures, assumes a pier
marina	L	includes piers, bulkheads, wharfs

2.3 Data Collection/Survey Techniques

Data collection is performed in the field, from a small, shoal draft vessel, navigating at slow speeds parallel to the shoreline. To the extent possible, surveys take place on a rising tide, allowing the boat to be as close to shore as possible. The field crew consists of a boat operator, and one surveyor. The boat operator navigates the boat to follow the shoreline geometry. The boat operator logs information relevant to shoreline structures. The surveyor collects information pertinent to land use and bank condition. Data is logged using either the handheld Trimble GeoExplorer, GeoExplorer 3, or GeoXT GPS unit. These units are accurate to within 4 inches of true position with extended observations, and differential correction. This level of accuracy has not be achieved in this project due to the observation requirements. Both static and kinematic data collection is performed.

Kinematic data collection is a collection technique where data is collected continuously along a pathway (in this case along the waterway). GPS units are programmed to collect information at a rate sufficient to compute a position anywhere along the course. Features are collected at a rate of one observation every five seconds. Land use, bank condition, and linear shoreline structures are collected using this technique.

Static surveys pin-point fixed locations that occur at very short intervals. The boat actually stops to collect these data, and the boat operator must hold the boat against tidal current, and surface wind waves. Static surveys log 10 GPS observations at a rate of one observation per second at the fixed station. The GPS receiver uses an averaging technique to compute one position based on the10 static observations. Static surveys are used to position point features like piers, boat ramps, and boat houses.

These Trimble GPS receivers include a function that allows a user to pre-program the complete set of features surveyed in a "data dictionary". The data dictionary prepared for this inventory includes all features described in section 2.2. As features are observed in the field, surveyors use scroll down menus to continuously tag each geographic coordinate pair with a suite of characteristics that describe the shoreland's land use, bank condition, and shoreline features present. The survey, therefore, is a complete set of geographically referenced shoreline data.

2.4 Data Processing

Data processing occurs in two parts. Part one processes the raw GPS field data, and converts the data to GIS coverages (section 2.4a). Part two corrects the GIS coverages to reflect true shoreline geometry (section 2.4b).

<u>2.4a. GPS Processing</u>: Differential correction improves the accuracy of GPS data by including other "known" locations to refine geographic position. Any GPS base station within 124 miles of the field site can serve as one additional location. A base station operated by the National Geodetic Survey in Horn Point, Maryland was used for most of the data processing in Dorchester County.

Differential correction is the first step to processing GPS data. Trimble's Pathfinder Office GPS software is used. The software processes time synchronized GPS signals from field data and the selected base station. Differential correction improves the position of the GPS field data based on the known location of the base station, the satellites, and the satellite geometry. When Selective Availability was turned off in late Spring, 2000, the need to post process data has nearly been eliminated for the level of accuracy being sought in this project.

Although the Trimble GeoExplorers are capable of decimeter accuracy (~ 4 inches), the short occupation of sites in the field reduces the accuracy to 5 meters (~16 feet). In many cases the accuracy achieved is better, but the overall limits established by the CCI program are set at 5 meters. This means that features are registered to within 5 meters (~16 feet) (or better) of their true position on the earth's surface. In this case, positioning refers to the boat position during data collection.

An editing function is used to clean the GPS data. Cleaning corrects for breaks in the data that occur when satellite lock is lost during data collection. Editing also eliminates erroneous data collected when the boat circles off track, and the GPS unit is not switched to "pause" mode.

The final step in GPS processing converts the files to three separate ArcInfo® GIS coverages. The three coverages are: a land use and bank condition coverage (stmco_lubc), a shoreline structure coverage (lines only) (stmco_sstruc), and a shoreline structure coverage (points only) (stmco_astruc).

2.4b. GIS Processing: GIS processing includes two major steps. They use ESRI's ArcInfo® GIS software, and ERDAS' Imagine® software. Several data sets are integrated to develop the final inventory products. The processing is intended to correct the new GIS coverages so they reflect conditions at the shoreline, and not along the boat track. All attributes summarized in Tables 1, 2, and 3 are included.

Step one generates a digital shoreline coverage to use as a basemap. Since existing shoreline coverages were considerably out of date and proved to be quite inaccurate, a new digital shoreline record was generated using photo-interpretation techniques and Digital Ortho Quarter Quadrangles (DOQQs) flown in1993. DOQQs are fully rectified digital imagery representing one quarter of a USGS 7.5 minute quadrangle. This imagery is later used as background imagery in data processing and map production. They are an important quality control tool for verifying the location of certain landscape attributes, and provide users with additional information about the coastal landscape.

In step one, the shoreline coverage is derived by interpreting the land water interface observed on 1993 DOQQs. While this process does not attempt to re-compute a shoreline position relative to a vertical tidal datum, it adjusts the horizontal geographic position to reflect the present shoreline geometry. Using ERDAS' Imagine® software, the DOQQ is displayed onscreen, and an operator digitizes the land water interface using photo-interpretation techniques. This new basemap does not represent a tidally corrected shoreline like other available datasets, however, the improved accuracy of the land water interface justifies the integration of this product for this project.

Step two in GIS processing corrects the coverages generated from the GPS field data to the new shoreline record. These coverages, having been processed through GPS software, are geographically coincident with the path of the boat, from where observations are made. They are, therefore, located somewhere in the waterway. Step two transfers these data back to the corrected shoreline record so the data more precisely reflect the location being described along the shore.

The majority of data processing takes place in step two where all three data sets are used simultaneously (new shoreline record, the field data as ArcInfo coverages, and the DOQQs). The imagery is used as background for reference. With the new shoreline as base coverage, the remaining processing re-codes this coverage to reflect the attributes mapped in the field data along the boat track. ArcGIS is used. Each time the boat track data indicates a change in attribute type or condition, the digital shoreline arc is split, and coded appropriately for the attributes.

This step endures a rigorous sequence of checks to insure the positional translation is as accurate as possible. The DOQQs in the background provide validation for some attributes and assist with coding. Each field coverage; land use, bank condition, and shoreline condition, is processed separately. The final products are three new coded shoreline coverages. Each coverage has been checked twice onscreen by different GIS personnel. A final review is done on draft hardcopy printouts.

2.4c. Photo interpreted shoreline: Remote sensing techniques are applied to areas where navigation was prohibited due to water depth, obstructions, weather, or tide. In a very few cases where field data was lost remote sensing may have been used rather than revisiting the area.

DOQQs provide the basemap from which data are interpreted. The resolution and scale of this product poses some limitations to what can be synthesized. Land use can be interpreted with a high degree of confidence. The imagery is also very good for identifying piers, breakwaters, and groinfields. Occasionally bulkheading can be seen because of the straight unnatural geometry of the shoreline. This is not always clear with riprap construction.

The imagery is not good for determining features describing the bank. Since the image is vertical and not oblique, conditions along the bank can not observed. Sometimes bank height is assumed based on surrounding conditions that have been surveyed.. Other times topographic maps are consulted. Assumptions are made about bank stability. Shoreline exposed to long fetches may be assumed to be erosional. If adjacent areas surveyed are erosional, the shoreline may be coded as erosional as well.

Natural buffers can sometimes be captured in DOQQ imagery. This depends on the width of the buffer. Wide sandy beaches and fringe marshes can frequently be delineated. Sand lenses and narrow fringe marshes are presumed to be missed. Since species identification is impossible with this imagery, no attempt to classify Phragmites australis is made.

The majority of Fishing Bay was surveyed using these remote sensing techniques. The large expansive marshes make it impossible to address land use in any other fashion. Since Fishing Bay has a lot of exposure the marsh buffer is assumed to be erosional. Little attempt to quantify structures has been made. Only piers are noted if visible in the imagery. Since there is generally very little development in Fishing Bay, there is very little shoreline alteration expected. On a plate by plate basis, Table 8 reports the number of miles photo analyzed for each plate.

2.4d. Maps and Tables: Color maps are generated to illustrate attributes surveyed along the shore. A three-part map series has been designed to illustrate the three tiers individually. Plate

A describes the riparian land use as color coded bars along the shore. A legend keys the color to the type of land use (e.g. yellow = residential).

Plate B depicts the condition of the bank and any natural buffers present. Four lines, and a combination of color and pattern symbology gives rise to a vast amount of bank and natural buffer information. Depending on the conditions between 2-4 lines may be illustrated. The length of the symbology along the shore reflects the length alongshore that the features persist. The symbology changes as conditions change.

The inland most line depicts bank cover. Bank cover is distinguished by colors. Bare banks (<25% cover) are illustrated in fuscia. Partial cover (25-75%) is illustrated in orange, and total cover (>75%) is indicated by an aqua blue line.

A bright blue line seaward of the bank cover delineation denotes the presence of Phragmites australis. This line will only appear if Phragmites was observed in the field. Table 8 reports the amount of Phragmites surveyed in the field.

Bank height and stability is plotted directly on the land/water interface (shoreline). Bank height varies with the thickness of the line; where the thinnest lines designate the lowest banks (0-5 ft), and thickest lines designate the highest banks (> 30 feet). If conditions along the bank were classified as "high erosion" the line will be red. If conditions were classified as "low erosion" the line will be green. Yellow is used if the bank is only undercut.

Natural buffers, when present, are described by small circles parallel and channelward of the shoreline. Open circles indicate a natural fringe marsh along the base of the bank. Solid circles indicate a sand beach buffer at the base of the bank. It is possible to have both. If condition of the buffer is considered highly erosional the circles are red. If conditions do not suggest this the circles are green (low erosion).

Plate C combines recreational and shoreline protection structures in a composition called Shoreline Features. Linear features, described previously, are mapped using color coded bar symbols that flow along the shoreline (e.g. yellow=bulkhead). Point features use a combination of colors and symbols to plot the positions (e.g. green dot=dock).

DOQQ imagery are used as backdrop on the maps. The shoreline data are superimposed. The original color infra red image is used as a backdrop on Plate A. A gray-scale version of this same image is used for Plates B and C.

For publication purposes the county is divided into a series of plates. Plates are scaled at 1:12,000 for publication at 11x17. Publications scale will vary if printed at a different size. The number of plates was determined by the geographic size and shape of Dorchester County. An index is provided on the website that illustrates the orientation of plates to each other. The county was divided into 70 plates (plate 1a, 1b, 1c, etc.), for a total of 210 map compositions. The index can be used to locate the plate containing an area of interest. Each plate must be individually selected and viewed from the list on the web page.

Tables 4-7 quantify features mapped along the rivers using frequency analysis techniques in ArcInfo. Tables 4 and 5 quantify features on a plate by plate basis with Table 4 reporting land use and bank conditions, and Table 5 reporting shoreline features (i.e. structures) . Tables 6 and 7 summarizes these same conditions by waterway. An online map illustrates these tributaries. Table 6 reports values for land use and bank condition. Table 7 lists shoreline features. For linear features, values are reported in actual miles surveyed. For points, the value represents the number of point features surveyed. The total miles of shoreline surveyed for each plate or tributary is given.

In Dorchester County, a total of 523.91 miles of shoreline were surveyed. Table 8 breaks down these shoreline miles by plate number and gives the survey dates. Miles of Phragmites australis noted in the field is also presented.

Since there is plate overlap, in tables 4 and 5, the total shoreline miles surveyed can not be calculated by adding miles surveyed for each plate. The last row of Tables 4 and 5 reports the total shoreline miles surveyed for the county (523.91 miles), and the total amount of each feature surveyed along the measured shoreline.

<u>2.4e. Access To Data:</u> An electronic version of this report along with all maps, tables and metadata are available online at the following url: http://ccrm.vims.edu/gis/gisdata.html under Shoreline Situation Reports (MD). The index can be used to determine the plate(s) that contain the area of interest. Tiles are organized by headings “Riparian Land Use”, “Bank an Buffer” and “Shoreline Features”. Additional instructions are provided on the website. Users are advised to read the Disclaimer and review the metadata record.

Chapter 3. Applications for Management

3.1 Introduction

There are a number of different management applications for which the Shoreline Situation Reports (SSRs) support. This section discusses four of them. The SSRs are data reports, and do not necessarily provide interpretation beyond the characteristics of the nearshore landscape. However, the ability to interpret and integrate these data into other programs is key to gleaming the full benefits of the product. This chapter offers some examples for how data from SSRs can be analyzed to support current state management programs.

3.2 Shoreline Management

The first uses for SSRs were to prepare decision makers to bring about well informed decisions regarding shoreline management. This need continues today, and perhaps with more urgency. In many areas, undisturbed shoreline miles are almost nonexistent. Development continues to encroach on remaining pristine reaches, and threatens the natural ecosystems which have prevailed. At the same time, the value of waterfront property has escalated, and the exigency to protect shorelines through stabilization has increased. Generally speaking, this has been an accepted management practice. However, protection of tidal shorelines does not occur without incidence.

Management decisions must consider the current state of the shoreline, and understand what actions and processes have occurred to bring the shoreline to its current state. This includes evaluating existing management practices, assessing shore stability in an area, and determining future uses of the shore. The SSRs provide data to perform these evaluations.

Plate A defines the land use adjacent to the shoreline. To the extent that land use directs the type of management practices found, these maps can predict shoreline strategies which may be expected in the future. Residential areas are prone to shoreline alterations. Commercial areas may require structures along the shore for their daily operations. Others frequently seek structural alternatives to address shoreline stability problems. Forested riparian zones, and large tracts of grass or agricultural areas are frequently unmanaged even if chronic erosion problems exist.

Stability at the shore is described in Plate B. The bank is characterized by its height, its cover, its state of erosion, and the presence or absence of natural buffers at the bank toe. Upland adjacent to high, stable banks with a stable natural buffer at the base are less prone to flooding or erosion problems resulting from storm activity. Upland adjacent to banks of lesser height (< 5 feet) are at greater risk of flooding, but if banks are stable with marshes or beaches present, erosion may not be a significant concern. Survey data reveals a strong correlation between banks of high erosion, and the absence of natural buffers. Conversely, the association between stable banks and the presence of marsh or beach is also well established. This suggests that natural buffers such as beaches and fringe marshes play an important role in bank protection. This is illustrated on the maps. Banks without natural buffers, yet classified as low erosion, are often structurally controlled with rip rap or bulkheads.

Plate C delineates structures installed along the shoreline. These include erosion control structures, and structures to enhance recreational use of the waterway. This map is particularly useful for evaluating requests from property owners seeking structural methods for controlling shoreline erosion problems. Shoreline managers can evaluate the current situation of the surrounding shore including: impacts of earlier structural decisions, proximity to structures on neighboring parcels, and vicinity to undisturbed lots. Alternative methods such as vegetative control may be evaluated by assessing the energy or fetch environment from the images. This plate in combination with Plate B can be used to evaluate the condition of the bank proposed for protection.

A close examination of shore conditions may suggest whether certain structural choices have been effective. Success of groin field and breakwater systems is confirmed when sediment accretion is observed. Low erosion conditions surveyed along segments with bulkheads and riprap indicate structures have controlled the erosion problem. The width of the shorezone, estimated from the background image, also speaks to the success of structures as a method of controlling erosion. A very narrow sandy shorezone implies that as bulkheads or riprap have secured the erosion problem at the bank, they have also deflated the supply of sediment available to nourish a healthy beach. This is a typical shore response, and remains an unresolved management problem.

Shoreline managers are encouraged to use all three plates together when developing management strategies or making regulatory decisions. Each plate provides important information independent of the others, but collectively the plates become a more valuable management tool. The resolution of the products, however, should not replace field visits when evaluating applications for construction.

3.3 Evaluating Shoreline Risk for Shoreline Erosion and Sea Level Rise

The Shoreline Erosion Task Force published findings in a report released in 2000 that states 31% of Maryland coastline is eroding (Shoreline Erosion Task Force, 2000). The problem persists in all 16 coastal counties. The final report identifies nine recommendations. Among them is the recommendation that erosion control strategies be developed regionally to address chronic erosion problems brought about by sea level or wave energy. These strategies should prioritize erosion control activities based on resource sensitivity and extent of the problem. As well, the recommendation calls for improved coordination to streamline and regionalize erosion control activities.

A Comprehensive Erosion Control Plan, as recommended by the Task Force, calls for the identification of shoreline experiencing erosion. The Shoreline Situation Reports now being generated on a county by county basis will provide insight into areas experiencing erosion, where sensitive habitat such as marshes are at risk, and where erosion control structures are currently in place. This information, combined with the ongoing effort to compute shoreline change rates along the shoreline will provide nearly all the information necessary to prioritize erosion control activities, and identify the type of erosion control measure most appropriate for the problem.

3.4 Non-Point Source Targeting

The identification of potential problem areas for non-point source pollution is a focal point of water quality improvement efforts throughout the Commonwealth. The three tiered approach provides a collection of data which, when combined, can allow for an assessment of potential non-point source pollution problems in a waterway.

Grass land and agricultural land, which includes pasture land and cropland, respectively, have the highest potential for nutrient runoff. These areas are also prone to high sediment loads since the adjacent banks are seldom restored when erosion problems persist. Residential, bare, and commercial land uses also have the potential to contribute to the non-point source pollution problem due to the types of practices which prevail, and large impervious surface areas.

The highest potential for non-point source pollution will be associated with these land uses if banks are classified with the following conditions: “high” bank erosion, bare or nearly bare bank cover, and no marsh buffer protection. The potential for non-point source pollution moderates as the condition of the bank changes from “high” bank erosion to “low” bank erosion, or with the presence or absence of stable marsh vegetation to function as a nutrient sink for runoff. Where defense structures occur in conjunction with “low” bank erosion, structures are effectively controlling erosion at this time, and the potential for non-point source pollution is reduced. If the following characteristics are delineated: low bank erosion, stable marsh buffer, riprap or bulkhead; the potential for non-point source pollution from any land use class can be lowered.

There are other factors that must also be assessed in evaluating the potential for non-point source pollution problems. Groundwater filtration, and soil erosion characteristics are a few. These factors should also be considered when making an evaluation.

At the other end of the spectrum, forested and scrub-shrub sites do not contribute significant amounts of non-point source pollution to the receiving waterway. Forest buffers, in particular, are noted for their ability to uptake nutrients running off the upland. Forested areas with stable or defended banks, a stable fringe marsh, and beach would have the lowest potential as a source of non-point pollution. Scrub-shrub with similar bank and buffer characteristics would also be very low.

A quick search for potential non-point source sites would begin on Plate A. Identify the “grass” or “agricultural” areas. Locate these areas on Plate B, and find those that have eroding banks (in red) without any marsh protection. The hot spots are these sites where the banks are highest (thick red line) and the potential sediment volume introduced to the water is greatest.

Finally check plate C to determine if any artificial stabilization to protect the bank has occurred. If these areas are without stabilizing structures, they indicate the hottest spots for the introduction of non-point source pollution.

3.5 Designating Areas of Concern (AOC) for Best Management Practice (BMP) Sites

Sediment load and nutrient management programs at the shore are largely based on installation of Best Management Practices (BMPs). Among other things, these practices include fencing to remove livestock from the water, installing erosion control structures, and bank re-vegetation programs. Installation of BMPs is costly. Cost share programs provide relief for property owners, but funds are scarce in comparison to the capacious number of waterway miles needing attention. Targeting Areas of Concern (AOC) can prioritize spending programs, and direct funds where most needed.

Data collected for the SSR can assist with targeting efforts for designating AOCs. AOCs can be areas where riparian buffers are fragmented, and could be restored.. The land use coverage and image illustrated in Plate A can help to identify breaks in the continuity of the riparian forest. Fragmentation is easily observed and potential sites for restoring the buffer can be detected. Agricultural or grass land that breach forest buffers are more logical targets for forest buffer restoration than residential or commercial stretches as they offer the highest opportunity for conversion.

Plate B can be used to identify sites for controlling erosion. Look for where “red” (i.e. eroding) bank conditions persist. The thickness of the line tells something about the bank height. The fetch, or the distance of exposure across the water, can offer some insight into the type of BMP which might be most appropriate. Re-vegetation may be difficult to establish at the toe of a bank with high exposure to wave conditions. Plate C should be checked for existing shoreline erosion structures in place.

Tippett et.al.(2000) used similar stream side assessment data to target areas for bank and riparian corridor restoration along the Rapidan River in Virginia. These data followed a comparable three tier approach. AOC’s were denoted using a protocol derived from the field data.

Chapter 4. The Shoreline Situation

The shoreline situation is described for conditions in Dorchester County, Maryland along primary and secondary shoreline. Characteristics are described for most navigable tidal waterways contiguous to these shorelines. A total of 523.91 miles of shoreline are described.

A summary of the plates is given below. Attribute tables and maps are available online. The online plate index illustrates the distribution of plates relative to each other. A second map illustrates the geography of the county's major tributaries. The GIS data is available for custom analyses

Plate Descriptions

Plate 1
Location: Binkhorn Creek to Hunting Creek
Major River: Choptank River

Shoreline Miles Surveyed:	3.62
Survey Date(s):	4/15/2003
Plate Rotation:	90 degrees W
Scale:	1:12,000

Plate 2
Location: vicinity of Cabin Creek
Major River: Choptank River

Shoreline Miles Surveyed:	6.24
Survey Date(s):	4/15/2003
Plate Rotation:	0 degrees
Scale:	1:12,000

Plate 3

Location: Vicinity of Warwick River

Major River: Choptank River

Shoreline Miles Surveyed: 6.83

Survey Date(s): 4/15/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 4

Location: Oyster Shell Point to Goose Creek

Major River: Choptank River

Shoreline Miles Surveyed: 6.15

Survey Date(s): 4/15/2003

Plate Rotation: 45 degrees E

Scale: 1:12,000

Plate 5

Location: Vicinity of Hurst Creek and White Hall Creek

Major River: Choptank River

Shoreline Miles Surveyed: 8.02

Survey Date(s): 4/15/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 6

Location: Cambridge, Maryland shoreline

Major River(s): Choptank River

Shoreline Miles Surveyed: 6.15

Survey Date(s): 4/14/2003, 4/15/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 7

Location: Jenkins Creek to Great Marsh Point

Major River: Choptank River

Shoreline Miles Surveyed: 4.24

Survey Date(s): 4/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 8

Location: Lecompte Bay, Horn Point

Major River(s): Choptank River

Shoreline Miles Surveyed: 4.13

Survey Date(s): 4/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 9

Location: Castle Haven Point to Lecompte Bay

Major River(s): Choptank River

Shoreline Miles Surveyed: 10.30

Survey Date(s): 4/14/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 10

Location: Vicinity of Chapel Creek

Major River(s): Choptank River

Shoreline Miles Surveyed: 6.87

Survey Date(s): 8/21/2002

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 11

Location: Todds Point

Major River(s): Choptank River

Shoreline Miles Surveyed: 12.92

Survey Date(s): 4/14/2003. 6/10/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 12

Location: Entrance Choptank River, Trippe Bay

Major River: Chesapeake Bay, Choptank River

Shoreline Miles Surveyed: 11.14

Survey Date(s): 4/14/2003, 8/14/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 13

Location: Trippe Bay, headwaters of Hudson Creek, Brooks Creek

Major River (s): Chesapeake Bay, Little Choptank River

Shoreline Miles Surveyed: 15.19

Survey Date(s): 6/9/2003, 6/10/2003, 8/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 14

Location: Brannock Bay and Brooks Creeks

Major River(s): Chesapeake Bay, Little Choptank River

Shoreline Miles Surveyed: 12.26

Survey Date(s): 6/9/2003, 8/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 15

Location: Casson Neck to Ragged Point

Major River: Chesapeake Bay, Little Choptank River

Shoreline Miles Surveyed: 11.53

Survey Date(s): 6/9/2003, 6/10/2003, 8/14/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 16

Location: Cason Neck to Ross Neck including:

Broad, Hudson, and Back Creeks

Major River(s): Little Choptank River

Shoreline Miles Surveyed: 22.75

Survey Date(s): 6/9/2003, 6/10/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 17

Location: entrance to Fishing and Beckwith Creeks

Major River: Little Choptank River

Shoreline Miles Surveyed: 12.86

Survey Date(s): 6/10/2003, 6/11/2003, 6/12/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 18

Location: headwaters of Beckwith and Phillip Creeks

Major River(s): Little Choptank River

Shoreline Miles Surveyed: 13.70

Survey Date(s): 6/12/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 19

Location: Town Point and Morris Necks

Major River(s): Little Choptank River

Shoreline Miles Surveyed: 12.08

Survey Date(s): 6/12/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 20

Location: Gary anc Lee Creeks

Major River: Choptank River

Shoreline Miles Surveyed: 11.88

Survey Date(s): 6/12/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 21

Location: McKeil Point including Fishing Creek and Madison Bay

Major River: Little Choptank River

Shoreline Miles Surveyed: 12.79

Survey Date(s): 6/11/2003, 6/12/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 22

Location: Fishing Creek and Church Creek

Major River (s): Little Choptank River

Shoreline Miles Surveyed: 16.74

Survey Date(s): 6/11/2003, 6/12/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 23

Location: Upper branches of Fishing Creek

Major River(s): Little Choptank River

Shoreline Miles Surveyed: 11.25

Survey Date(s): 6/11/2003, 6/12/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 24

Location: Church Creek

Major River: Little Choptank River

Shoreline Miles Surveyed: 9.09

Survey Date(s): 6/11/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 25

Location: Susquehanna and Wollford Neck

Major River: Little Choptank River

Shoreline Miles Surveyed: 10.55

Survey Date(s): 6/11/2003, 7/15/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 26

Location: Susquehanna Neck to Slaughter Creek

Major River: Little Choptank River

Shoreline Miles Surveyed: 7.82

Survey Date(s): 7/15/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 27

Location: Cators Cover to Holland Point

Major River: Little Choptank River

Shoreline Miles Surveyed: 7.65

Survey Date(s): 7/15/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 28

Location: Taylor’s Island

Major River(s): Chesapeake Bay

Shoreline Miles Surveyed: 6.97

Survey Date(s): 7/15/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 29

Location: Slaughter Creek and Slaughter Creek Broads

Major River: Little Choptank River

Shoreline Miles Surveyed: 10.15

Survey Date(s): 7/15/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 30

Location: Taylor’s Island

Major River: Chesapeake Bay

Shoreline Miles Surveyed: 2.73

Survey Date(s): 7/15/2003

Plate Rotation: 60 degrees W

Scale: 1:12,000

Plate 31

Location: Entrance to Saint John and Punch Island Creek

Major River: Chesapeake Bay

Shoreline Miles Surveyed: 2.92

Survey Date(s): 7/15/2003

Plate Rotation: 60 degrees W

Scale: 1:12,000

Plate 32

Location: From south of Punch Island Creek to Long Marshes

Major River(s): Chesapeake Bay

Shoreline Miles Surveyed: 3.72

Survey Date(s): 7/15/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 33

Location: Meekins Neck

Major River(s): Chesapeake Bay

Shoreline Miles Surveyed: 10.05

Survey Date(s): 7/14/2003, 7/15/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 34

Location: Upper Hooper Island and Tar Bay

Major River(s): Chesapeake Bay and Honga River

Shoreline Miles Surveyed: 15.75

Survey Date(s): 7/14/2003, 7/15/2003

Plate Rotation: 75 degrees W

Scale: 1:12,000

Plate 35

Location: Hooper Island

Major River: Back Creek to Ferry Point

Shoreline Miles Surveyed: 7.64

Survey Date(s): 7/14/2003, 7/15/2003

Plate Rotation: 75 degrees W

Scale: 1:12,000

Plate 36

Location: Middle Hooper Island

Major River(s): Honga River and Chesapeake Bay

Shoreline Miles Surveyed: 12.45

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 37

Location: Middle Hooper Island

Major River(s): Honga River and Chesapeake Bay

Shoreline Miles Surveyed: 10.86

Survey Date(s): 7/14/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 38

Location: Middle Hooper and Lower Hooper Island

Major River(s): Honga River and Chesapeake Bay

Shoreline Miles Surveyed: 12.59

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 39

Location: Keenes Point and entrance to Wallace Creek

Major River(s): Honga River

Shoreline Miles Surveyed: 12.28

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 40

Location: headwaters of Honga with Dicks Point, Great Marsh Creek and Wallace Creek Marsh

Major River(s): Honga River

Shoreline Miles Surveyed: 8.85

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 41

Location: Kirwan Neck to Seven Oak Point

Major River(s): Honga River

Shoreline Miles Surveyed: 4.68

Survey Date(s): 7/14/2003

Plate Rotation: 60 degrees W

Scale: 1:12,000

Plate 42

Location: Wroten Island, Parks Neck and entrance to Charles Creek

Major River(s): Honga River

Shoreline Miles Surveyed: 10.82

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 43

Location: Asquith Island, Lakes Cove, Fox Creek

Major River(s): Honga River

Shoreline Miles Surveyed: 11.29

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 44

Location: Asquith Island

Major River(s): Honga River

Shoreline Miles Surveyed: 9.03

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 45

Location: Negro Cover to Hearns Cover

Major River(s): Fox Creek

Shoreline Miles Surveyed: 11.74

Survey Date(s): 7/14/2003

Plate Rotation: 70 degrees W

Scale: 1:12,000

Plate 46

Location: Hearns Cove to Crab Point

Major River(s): Honga River and Fox Creek

Shoreline Miles Surveyed: 9.71

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 47

Location: Jimson Weed Marsh to Hog Island

Major River(s): Honga River

Shoreline Miles Surveyed: 8.09

Survey Date(s): 7/14/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 48

Location: Bishops Head Marsh from Jenny Island to entrance of Tedious Creek

Major River(s): Fishing Bay and Hooper Straight

Shoreline Miles Surveyed: 11.95

Survey Date(s): 7/14/2003, 7/16/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 49

Location: Goose Creek and Tedious Creek from Fishing Point to Ruben Point

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 11.21

Survey Date(s): 7/16/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 50

Location: Roasting Ear Point to Old House Point

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 4.94

Survey Date(s): 7/14/2003

Plate Rotation: 90 degrees E

Scale: 1:12,000

Plate 51

Location: Sheep Island Point to Thorofare Point

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 6.00

Survey Date(s): 7/16/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 52

Location: Thorofare Creek to Blackwater River

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 6.76

Survey Date(s): 7/16/2003

Plate Rotation: 90 degrees E

Scale: 1:12,000

Plate 53

Location: Transquaking River

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 5.13

Survey Date(s): 7/16/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 54

Location: Irish Creek Island Creek

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 4.83

Survey Date(s): 7/16/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 55

Location: Island Creek and Grays Island Marsh

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 5.92

Survey Date(s): 7/16/2003

Plate Rotation: 90 degrees W

Scale: 1:12,000

Plate 56

Location: Fishing Point

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 5.45

Survey Date(s): 7/16/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 57

Location: McCready's Cove to Duck Island Cove

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 5.56

Survey Date(s): 7/16/2003

Plate Rotation: 70 degrees W

Scale: 1:12,000

Plate 58

Location: Duck Island Cove to Sandy Island Cove

Major River(s): Fishing Bay

Shoreline Miles Surveyed: 6.60

Survey Date(s): 7/16/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 59

Location: Sandy Island Marsh

Major River(s): Fishing Bay, Nanticoke River

Shoreline Miles Surveyed: 9.65

Survey Date(s): 3/24/2003, 7/16/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 60

Location: Mulberry Point

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.68

Survey Date(s): 3/24/2003

Plate Rotation: 90 degrees E

Scale: 1:12,000

Plate 61

Location: Swamp Creek Cove to Newfoundland Point

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.87

Survey Date(s): 3/24/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 62

Location: Lowe and Upper Greens Cove

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.15

Survey Date(s): 3/24/2003

Plate Rotation: 0 degrees

Scale: 1:12,000

Plate 63

Location: Jacks Creek to Chapter Point

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.69

Survey Date(s): 3/24/2003

Plate Rotation: 90 degrees E

Scale: 1:12,000

Plate 64

Location: Penknife Point

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 4.15

Survey Date(s): 3/24/2003

Plate Rotation: 90 degrees E

Scale: 1:12,000

Plate 65

Location: North of Penknife Point to Point No Point Marsh

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.50

Survey Date(s): 3/24/2003

Plate Rotation: 45 degrees E

Scale: 1:12,000

Plate 66

Location: Butlers Beach

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.54

Survey Date(s): 3/24/2003

Plate Rotation: 90 degrees E

Scale: 1:12,000

Plate 67

Location: Town of Vienna

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 3.59

Survey Date(s): 3/25/2003

Plate Rotation: 45 degrees E

Scale: 1:12,000

Plate 68

Location: Big Creek Marsh

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 2.54

Survey Date(s): 3/25/2003

Plate Rotation: 45 degrees E

Scale: 1:12,000

Plate 69

Location: Entrance to Marshyhope Creek

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 2.72

Survey Date(s): 3/25/2003

Plate Rotation: 45 degrees E

Scale: 1:12,000

Plate 70

Location: Route 313 to county boundary with Sussex, Delaware

Major River(s): Nanticoke River

Shoreline Miles Surveyed: 2.51

Survey Date(s): 3/25/2003

Plate Rotation: 45 degrees E

Scale: 1:12,000

Glossary of Shoreline Features Defined

Agricultural - Land use defined as agricultural includes farm tracts which are cultivated and crop producing. This designation is not applicable for pasture land.

Bare - Land use defined as bare includes areas void of any vegetation or obvious land use. Bare areas include those which have been cleared for construction.

Beaches - Beaches are sandy shores which are subaerial during mean high water. These features can be thick and persistent, or very thin lenses of sand.

Boat house - A boathouse is considered any covered structure alongside a dock or pier built to cover a boat. They include true "houses" for boats with roof and siding, as well as awnings which offer only overhead protection. Since nearly all boat houses have adjoining piers, piers are not surveyed separately, but are assumed. Boat houses may be difficult to see in aerial photography. On the maps they are denoted with a blue triangle.

Boat Ramp - Boat ramps provide vessels access to the waterway. They are usually constructed of concrete, but wood and gravel ramps are also found. Point identification of boat ramps does not discriminate based on type, size, material, or quality of the launch. Access at these sites is not guaranteed, as many may be located on private property. The location of these ramps was determined from static ten second GPS observations. Ramps are illustrated as purple squares on the maps.

Breakwaters - Breakwaters are structures which sit parallel to the shore, and generally occur in a series along the shore. Their purpose is to attenuate and deflect incoming wave energy, protecting the fastland behind the structure. In doing so, a beach may naturally accrete behind the structures if sediment is available. A beach nourishment program is frequently part of the construction plan

The position of the breakwater offshore, the number of breakwaters in a series, and their length depends on the size of the beach which must be maintained for shoreline protection. Most breakwater systems sit with the top at or near MHW and are partially exposed during low water. Breakwaters can be composed of a variety of materials. Large rock breakwaters, or breakwaters constructed of gabion baskets filled with smaller stone are popular today. Breakwaters are not easily observed from aerial imagery. However, the symmetrical cuspate sand bodies which may accumulate behind the structures can be. In this survey, individual breakwaters are not mapped. The first and last breakwater in the series are surveyed as a ten-second static GPS observation. The system is delineated on the maps as a line paralleling the linear extent of the breakwater series along the shore.

Bulkhead - Bulkheads are traditionally treated wood or steel “walls” constructed to offer protection from wave attack. More recently, plastics are being used in the construction. Bulkheads are vertical structures built slightly seaward of the problem area and backfilled with suitable fill material. They function like a retaining wall, as they are designed to retain upland soil, and prevent erosion of the bank from impinging waves. The recent proliferation of vertical concrete cylinders, stacked side by side along an eroding stretch of shore offer similar level of protection as bulkheads, and include some of the same considerations for placement and success. These structures are also included in the bulkhead inventory.

Bulkheads are found in all types of environments, but they perform best in low to moderate energy conditions. Under high energy situations, the erosive power of reflective waves off bulkheads can scour material from the base, and cause eventual failure of the structure.

Bulkheads are common along residential and commercially developed shores. From aerial photography, long stretches of bulkheaded shoreline may be observed as an unnaturally straight or angular coast. In this inventory, they are mapped using kinematic GPS techniques. The data are displayed as linear features on the maps.

Commercial - Commercial zones include small commercial operations as well as parks or campgrounds. These operations are not necessarily water dependent businesses.

Dock/Pier - In this survey, a dock or pier is a structure, generally constructed of wood, which is built perpendicular or parallel to the shore. These are typical on private property, particularly residential areas. They provide access to the water, usually for recreational purposes. Docks and piers are mapped as point features on the shore. Pier length is not surveyed. In the map compositions, docks are denoted by a small green dot. Depending on resolution, docks can be observed in aerial imagery, and may be seen in the maps if the structure was built prior to 1994, when the photography was taken.

Forest Land Use - Forest cover includes deciduous, evergreen, and mixed forest stands greater than 18 feet high. The riparian zone is classified as forested if the tree stand extends at least 33 feet inland of the seaward limit of the riparian zone.

Grass - Grass lands include large unmanaged fields, managed grasslands adjacent to large estates, agriculture tracts reserved for pasture, and grazing.

Groinfield - Groins are low profile structures that sit perpendicular to the shore. They are generally positioned at, or slightly above, the mean low water line. They can be constructed of rock, timber, or concrete. They are frequently set in a series known as a groinfield, which may extend along a stretch of shoreline for some distance.

The purpose of a groin is to trap sediment moving along shore in the littoral current. Sediment is deposited on the updrift side of the structure and can, when sufficient sediment is available in the system, accrete a small beach area. Some fields are nourished immediately after construction with suitable beach fill material. This approach does not deplete the longshore sediment supply, and offers immediate protection to the fastland behind the system.

For groins to be effective there needs to be a regular supply of sediment in the littoral system. In sediment starved areas, groin fields will not be particularly effective. In addition they can accelerate erosion on the downdrift side of the groin. The design of “low profile” groins was intended to allow some sediment to pass over the structure during intermediate and high tide stages, reducing the risk of down drift erosion.

From aerial imagery, most groins cannot be observed. However, effective groin fields appear as asymmetrical cusps where sediment has accumulated on the updrift side of the groin. The direction of net sediment drift is also evident.

This inventory does not delineate individual groins. In the field, the first and last groin of a series is surveyed. Others between them are assumed to be evenly spaced. On the map composition, the groin field is designated as a linear feature extending along the shore.

Industrial - Industrial operations are larger commercial businesses.

Marina - Marinas are denoted as line features in this survey. They are a collection of docks and wharfs which can extend along an appreciable length of shore. Frequently they are associated with extensive bulkheading. Structures associated with a marina are not identified individually. This means any docks, wharfs, and bulkheads would not be delineated separately. Marinas are generally commercial operations. Community docks offering slips and launches for community residents are becoming more popular. They are usually smaller in scale than a commercial operation. To distinguish these facilities from commercial marinas, the riparian land use map (Plate A) will denote the use of the land at the site as residential for a community facility, rather than commercial.

Marshes - Marshes can be extensive embayed marshes, or narrow, fragmented fringe marshes. The vegetation must be relatively well established, although not necessarily healthy.

Miscellaneous - Miscellaneous point features represent short isolated segments along the shore where material has been dumped to protect a section of shore undergoing chronic erosion. Longer sections of shore are illustrated as line features. They can include tires, bricks, broken concrete rubble, and railroad ties as examples.

Paved - Paved areas represent roads which run along the shore and generally are located at the top of the banks. Paved also includes parking areas such as parking at boat landing, or commercial facilities.

Residential - Residential zones include rural and suburban size plots, as well as multi-family dwellings.

Riprap - Generally composed of large rock to withstand wave energy, riprap revetments are constructed along shores to protect eroding fastland. Revetments today are preferred to bulkhead construction. They reduce wave reflection which causes scouring at the base of the structure, and are known to provide some habitat for aquatic and terrestrial species. Most revetments are constructed with a fine mesh filter cloth placed between the ground and the rock. The filter cloth permits water to permeate through, but prevents sediment behind the cloth from being removed, and causing the rock to settle. Revetments can be massive structures, extending along extensive stretches of shore, and up graded banks. When a bulkhead fails, riprap is often placed at the base for protection, rather than a bulkhead replacement. Riprap is also used to protect the edge of an eroding marsh. This use is known as toe protection. This inventory does not distinguish among the various types of revetments.

Riprap revetments are popular along residential waterfront as a mechanism for stabilizing banks.   Along commercial or industrial waterfront development such as marinas, bulkheads are still more common since they provide a facility along which a vessel can dock securely.

Riprap is mapped as a linear feature using kinematic GPS data collection techniques. The maps illustrate riprap as a linear feature along the shore.

Scrub-shrub - Scrub-shrub zones include trees less than 18 feet high, and is usually dominated by shrubs and bushy plants.

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