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Tidal Shoreline Erosion in Northern Virginia

Prepared by the

Northern Virginia Planning District Commission

September, 1992

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This report is an NVPDC staff product to the Virginia Council on the Environment in partial fulfillment of a grant received from the 1992 Coastal Zone Management Act, as administrated by the National Oceanic and Atmospheric Administration. Any assessments and conclusions contained in this report represent the results of the staff's technical investigation, and do not represent policy positions of the Northern Virginia Planning District Commission unless so stated in an adopted resolution of said Commission.

TIDAL SHORELINE EROSION IN NORTHERN VIRGINIA

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Tidal Shoreline Erosion in Northern Virginia

I. EXECUTIVE SUMMARY

The Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service (SEAS) provides technical advice, site specific planning, and partial financial assistance for installation of erosion control measures to property owners of tidal shoreline properties in Virginia, who request this service. The program is intended to reduce the amount of sediment entering tidal waters from uncontrolled shoreline erosion from surface runoff, wave or tidal action. Intended to provide assistance to all tidal shoreline property owners in Virginia, SEAS does not have the personnel, nor the financial resources at this time to prepare a complete data base of applicable property owners for purposes of program outreach and technical support.

To assist SEAS, and also provide valuable information to local jurisdictions, the Virginia Marine Resources Commission, and the U.S. Army Corps of Engineers; a grant was provided by the Coastal Zone Management Act of 1972, as administered by the National Oceanic and Atmospheric Administration, through the Virginia Council on the Environment to the Northern Virginia Planning District Commission (NVPDC), to pursue this investigation and update the erosion findings contained in the original 1976 and 1979 Shoreline Situation Reports, produced by the Virginia Institute of Marine Sciences (VIMS) for Arlington, Fairfax and Prince William counties, and the City of Alexandria. This report update identifies more recent "priority" locations of actual and potential shoreline erosion concern, as well as locations of shoreline currently protected. The ultimate objective of this effort being: targeting and eliminating tidal shoreline erosion, thereby leading to improved water quality in the Potomac River and its tidal tributaries.

Within this report, the Northern Virginia tidal shoreline is divided for purposes of analysis into twenty-one separate shoreline segments. **Appendix 1** contains descriptions of each segment in terms of the erosion situation and artificial shoreline stabilization. Also described are approximate erosion rates for significant erosion areas that have been identified through this investigation. Maps showing the locations of "priority" erosion concern and locations of already protected shoreline areas have also been included. This update is intended to serve as a valuable resource document for state and local officials to assist them in planning for shoreline and erosion control throughout Northern Virginia.

In order to ensure useful and valuable final products, the following project tasks were performed:

- NVPDC met with the Shoreline Erosion Advisory Service (SEAS) representative at the outset to coordinate the project, obtain important

information and discuss the shoreline surveys. This initial meeting was tremendously informative and helped ensure the project was conducted in the proper manner from the beginning.

- The Shoreline Situation Reports (SSR), produced by the Virginia Institute of Marine Sciences for Prince William County (Roberts, *et. al.* 1976) and for the Counties of Fairfax and Arlington, and the City of Alexandria (Owen, *et. al.* 1979), were reviewed. A summary of the information contained in the SSR, including original sources of information, is detailed in **Appendix 2.**

  The reader should note, however, that the techniques used to measure and define shoreline lengths, length of artificial stabilization structures and overall study area, although comparable, differ slightly between this investigation and previous SSRs. Care must therefore be exercised when comparing results between the two time periods, that any conclusions that are drawn take into consideration these minor differences.

- A set of basemaps was prepared and used as working drafts in the field, to assist in identifying the shoreline subsegments used in the SSR, and also used to mark areas identified as eroding or artificially stabilized in the SSR. These maps have since been revised and incorporated into the final maps as part of this report.

- Agencies were identified that would be interested in tidal shoreline erosion in Northern Virginia. A mailing list of those agencies is included in **Appendix 3.**

- A meeting was subsequently held with the various agencies interested in tidal shoreline erosion to further guide the project and receive necessary feedback.

- Research was conducted to ascertain what information other agencies use to delineate the inland extent of tidal influence in Northern Virginia. The working basemaps were subsequently revised to include the inland extent of tidal influence, and incorporated into the final maps found in this report.

- A review of the literature, maps, and charts was similarily conducted and new sources of information identified that was not used in the original SSRs, including other ongoing research activities that involve the shorelines in the study area. A summary report on new and potential sources of information on shoreline erosion in Northern Virginia is included in **Appendix 4.**

- An aerial survey was conducted of the study area and a set of oblique photographic slides taken 500 feet above the water, along the entire Potomac River from National Airport south to Quantico, Virginia -- later used for interpretation and analysis. The study area in controlled airspace north of National was surveyed by boat. Structures were subsequently noted along the entire Northern Virginia Potomac River shoreline and each of the embayments.

- Finally, a workshop was coordinated with the interested agencies to view the slides and get their input and comments. The photographs and boat survey results were subsequently used to identify and map shore protection structures along the entire length of the Northern Virginia Potomac River shoreline; and later compared with property tax maps and shoreline changes maps (described below), to target specific property owners in high priority areas for future SEAS outreach and technical support.

In summary, this report highlights areas of erosion, erosion rates and locations of erosion control structures along the entire Northern Virginia tidal Potomac shoreline. In addition, this report augments a DBase IV computer data file, also created by NVPDC, that contains the names, mailing addresses, and tax parcel numbers of tidal Potomac shoreline property owners, that have been distributed to SEAS and Northern Virginia local governments. Combined with the set of approximately 360 low altitude aerial photographs, these work products shall serve as an excellent historical record for current planning efforts, and also future research.

II. INTRODUCTION

In the interest of protecting and preserving private property, recreational areas, cultural and historic resources, wetland habitat, and water quality; information on the shoreline erosion situation of Northern Virginia's tidal shorelines is needed. The main purpose of this report is to identify particular areas of Northern Virginia's tidal shoreline that need priority shoreline erosion planning and implementation action. In order to accomplish this objective, included in this report are a series of maps of the tidal shorelines of Northern Virginia, delineating shoreline changes as well as locations of shoreline stabilization structures. These maps and their associated textual descriptions can serve as an information base from which planners and scientists can identify problem areas requiring further investigation and target remedial action.

Study Area

Prince William, Fairfax, and Arlington Counties and the City of Alexandria all have tidal shorelines along the Potomac River and its associated embayments and tributaries. The southern boundary of this study is the jurisdictional boundary between Prince William and Stafford counties, occurring just south of Quantico at Chopawamsic Creek. The northern boundary of the study area is the head of tide of the Potomac River, near Little Falls, in the vicinity of Chain Bridge.

The Potomac River is the largest tributary to the ancient Susquehanna River, whose lower valley basin was flooded during the retreat of the last great ice age, becoming what is now known as the Chesapeake Bay. The Potomac River's tidal portion extends about 98 nautical miles from Little Falls to the confluence with the Bay. As shown in Figure 1, this report covers the approximate upper 33 nautical miles of the Potomac River, draining approximately 355,360 acres of land from the City of Alexandria, and Arlington, Fairfax, and Prince William Counties (LIPPSON, *et al.*, 1979).

In addition to the Potomac River shoreline of Northern Virginia, the shorelines of the tidal portions of the following areas have also been included in this study: Quantico Creek, Powells Creek, Neabsco Creek, Occoquan Bay, Farm Creek, Marumsco Creek, Belmont Bay, the Occoquan River, Massey Creek, Kanes Creek, Gunston Cove, Pohick Bay, Accotink Bay, Dogue Creek, Little Hunting Creek, Hunting Creek, Fourmile Run, Roaches Run, and the Boundary Lagoon.

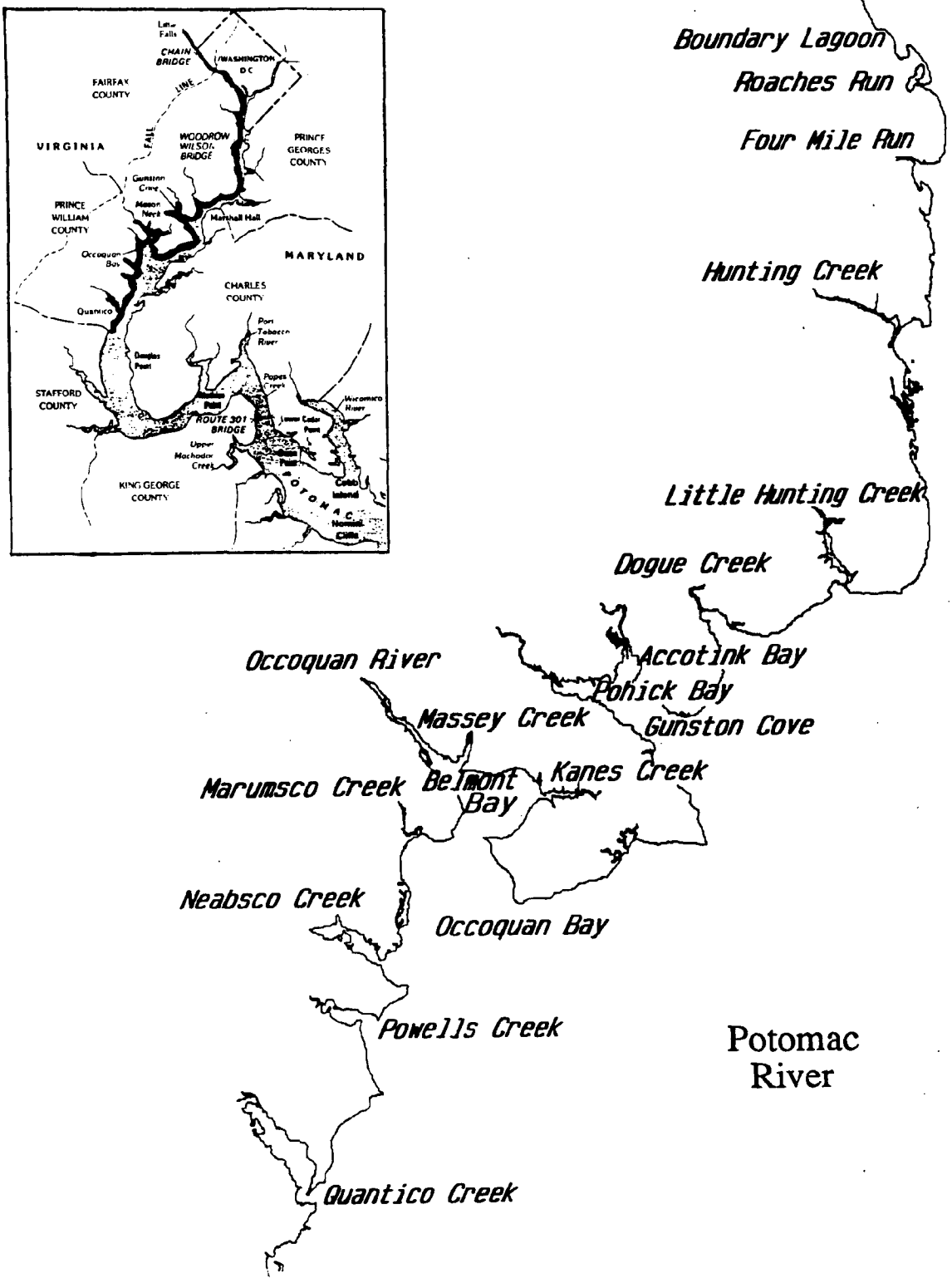


Figure 1: Water Bodies Located Along The Study Area.

Tidal Shorelines

Delineation of the tidal shorelines of Northern Virginia requires the identification of the inland extent of tidal influence along tributaries of the Potomac River. A natural barrier in the river can limit the tidal penetration; for example, the tidal waters of the Potomac River are blocked from upstream passage at the Fall Line, a natural line of demarcation, which occurs around Little Falls. A man-made barricade can also limit tidal influence; for example, along the Occoquan River tidal influence only extends to the Lower Occoquan Dam. Without natural or man-made barricades, the inland extent of tidal influence is not a permanent boundary; rather, it changes seasonally with land use changes, with wind direction and storms.

The best method of identifying the limit of tidal penetration along the tributaries is through observation. For this report, the observations made on tidal influence at road crossings, in the publication: Use of Virginia's Tributaries of the Potomac River by Anadromous Fishes (ODOM, *et al.*, 1988), were used to assist in establishing the inland penetration of the tidal head in tributaries of the Potomac River.

III. SHORELINE EROSION

The shoreline is the boundary between the land and the water. Both the water and the land are dynamic through time, resulting in receding shorelines (erosion) or advancing shorelines (accretion). Over long periods of time sea level rise, drought cycles, and land use influences water levels and therefore the position of the shoreline. Changes in land use, such as deforestation and development, will change the patterns of runoff, as well as the level of the water table and baseflow. Seasonal changes in precipitation and runoff, and human controlled additions and withdrawal of water from the Potomac River, and its tributaries also affect water levels. Over shorter periods of time, the water level is affected by daily tides and atmospheric conditions.

Shoreline erosion occurs when natural forces remove more material from the boundary than is deposited, resulting in an advance of the water towards the land, or recession of the boundary. Shoreline accretion occurs when more material is deposited than is removed, so that the boundary between the water and the land moves towards the water. If the amount of material removed is equivalent to the amount of material accumulated, the shoreline is said to be in dynamic equilibrium. Shoreline changes are time dependent. Although some shorelines appear to continuously erode or accrete, the most significant shoreline changes are usually episodic and are associated with storm events. For example, a shoreline that has been accreting for a period of time can erode during a single storm. Relative shoreline changes must therefore be associated with a specific time frame.

It is important to identify locations of shoreline erosion because of the potential loss of private property, recreational areas, cultural and historic resources, waterfront access, wetlands and wildlife habitat. Additionally, eroded sediment and nutrients can affect the water quality and ecological resources of adjacent bodies of water. Tidal shoreline erosion in Northern Virginia contributes to the non-point source pollution in the Potomac River and also the Chesapeake Bay. Unlike point-source pollution, which is traceable to a well defined source, non-point source pollution occurs over large areas. Identification of eroding areas will assist in the evaluation of the sources of sediments and associated nutrients. Areas of rapid accretion are also important to identify because they may be indicative of extreme sediment runoff from inland, or from downdrift shoreline erosion.

Wind-induced waves, littoral currents, tidal currents, sea-level rise, boat wake, and also storm runoff are the main assailing forces that result in shoreline erosion of the tidal Potomac River and its tributaries. The impact of these forces are influenced by the physical characteristics of the shorezone such as topography, type of shoreline, and resistance or cohesiveness of coastal materials.

Waves

Wave energy is a function of the wind velocity, duration, and the fetch length or distance of open water across which the wind blows. Along the Potomac River, winds from the north and northwest are dominant from October to April, and south and southwest winds are dominant between May and September. (MILLER, A. J., 1987). The north and northwest winds are generally stronger, but the south and southeast winds are more likely to cause substantial rise in water levels by driving water up the Potomac River. Less frequent but severe storms with strong northeast winds generate waves that can do significant damage in relatively short periods of time.

Currents

Waves and tidal activity produce currents. Waves approaching the shoreline refract as they enter shallow water, to break approximately shore parallel; but the refraction process is not complete, and a current is generated along the shore in the direction of refraction. The strength of the longshore current and its transportation capacity is a function of the wave energy and amount of refraction, as well as the interactions of other currents. Although the direction of longshore transport changes with changing wave conditions, the net effect over time can produce "downdrift" accumulation of eroded sediments. For example, the longshore current may transport sediment downdrift of an eroding cliff to form a beach. If the cliff erosion is reduced or eliminated by artificial stabilization of the shoreline, the downdrift beach may become sediment-starved and subsequently erode.

The flood (upstream) and ebb (downstream) of the tide also produce tidal currents in the Potomac River. Peak velocities generally occur only for short periods of time during the rising or falling tide. Ebb currents generally have a higher velocity than flood currents, and often follow different paths, thereby having different affects on sediment transportation. The astronomical tidal cycles also influence the strengths of the currents. The strongest tidal currents in the study area occur around Hallowing Point where the ebb current has a peak velocity of about 1.8 ft/sec (LIPPSON, *et al.*, 1979).

Tides

The tidal range and coastal topography determine the width of the shore zone over which waves and currents impact the coast. On a steep coast, the width of the zone over which the hydraulic forces are spread is less wide than for a gently sloping coast with the same tidal range. In two coastal areas with similar topography, the shore zone is wider for the area with the larger tidal range. The

waves strike the coast at a higher elevation at high tide than at low tide and therefore, the position of the tide during a storm event is significant.

Tidal fluctuations exhibit daily, monthly, and annual patterns due to the astronomical relationships between the earth, the sun, and the moon. Each day there are two high and two low tides along the Potomac River. These semidiurnal tides have a period of 12 hours and 25 minutes so that the high tides occur 50 minutes later on a subsequent day. The amplitude of the tide varies such that there is a higher-high tide, and lower-high tide each day. Bimonthly, when the sun and moon are in line with the earth, spring tides of greater amplitude occur. Approximately two weeks later, when the sun and moon are at right angles, neap tides of the least amplitude occur. When the earth is closest to the sun in the winter, larger spring tides occur than during summer months.

The tidal range varies spatially with the primary determinant being the shape of the coast. Tidal amplitudes can actually increase as a progressive tidal wave attenuates upstream in a funnel shaped tributary. As the cross section of a tributary gets smaller, the bore of tidal water has a greater effect. For example, along the Potomac Estuary, the river decreases in width upstream from nearly 10 miles at its confluence with the Chesapeake Bay to just over 200 ft at Chain Bridge. Therefore, the tidal range is significantly greater at Chain Bridge (approximately 2.9 ft.) than at mouth of the Potomac River (approximately 1.2 ft.) (LIPPSON, *et al.*, 1979).

Sea Level

The Potomac River Valley was flooded as sea level rose when glaciers started melting between 15,000 and 20,000 years ago to attain its approximate shape as we know it today (KOMAR *et al.*, 1991). Sea level continues to rise at approximately 0.01 ft/year in the vicinity of Washington D.C. (HICKS and HICKMAN, 1988). The distance of inland inundation associated with sea level rise depends on the coastal slope and relief. A relatively flat slope permits a small rise in sea level to cause a large distance of shoreline recession. Rosen (1978) estimated that all of the long term shoreline retreat that has been observed along the shorelines of the Chesapeake Bay can be accounted for by local rates of sea level rise. Although other processes contribute to shoreline erosion, sea level rise is the single most consistent factor causing shoreline recession over long periods of time.

Land Characteristics

The underlying geology and topographic conditions determine the type of shoreline. Low bluffs, high bluffs, flat sloping plains, beaches, and wetlands are

the common types of tidal shorelines in Northern Virginia. Unconsolidated sedimentary deposits forming beaches and wetlands can accrete and erode by sediment transportation along shore, or in an onshore/offshore direction. Accretion on a bluff shoreline can only occur from an accumulation of material at the base of the bluff as a talus deposit or a beach. The bluffs themselves can only erode.

Variations in the composition and cohesiveness of the exposed materials at the shoreline are the key factors in the resistance of the coast to erosion. For example, a bluff section composed of sand will erode faster than an adjoining bluff section composed of rock when exposed to similar conditions, resulting in a faster rate of shoreline retreat along the less resistive section. Similarly, in a bluff composed of layers of various sedimentary materials, the layers can erode at different rates. For example, a bluff with a layer of gravel behind a layer of sand and exposed at the coastline may erode fairly rapidly until the sandy layer is completely gone; at which time the layer of gravel becomes exposed and the erosion rate decreases. If a layer of sand is at the toe of a cliff overlain by a layer of gravel, the underlying layer will erode more rapidly, thereby undermining the stability of the bank and resulting in periodic mass movement of debris from the head to the toe of the cliff. The toe is then temporarily protected by the talus, which eventually erodes away - once again exposing the base of the cliff to erosive forces. Similar slope processes occur due to spatial variations in exposure to erosive processes; for example, in a bluff of homogeneous composition the toe is exposed to the direct impact of waves and currents which will result in the undermining process described above.

Human Activities

Land use, dredging river channels and harbors, building artificial shoreline stabilization structures, and boat wake can all influence coastal erosion. During the early settling of the Northern Virginia area, forests were cleared and tobacco was planted. Increased soil runoff to the coast, sedimentation in tributary areas, and changes in storm runoff patterns caused shoreline changes and pollution of the Potomac River with sediment and nutrients. The history of land use has influenced the observed shoreline changes. A good example of human influenced shoreline changes is occurring in Dike Marsh, located along the George Washington Memorial Highway. For years, the area was a dumping ground for dirt and gravel removed from other sites. A raised road was built so that dump trucks could drive their loads out into the marsh. The dumped sediments would at first choke the marsh vegetation, but then would settle and provide new areas for marsh expansion. Eventually the dumping was outlawed and the existing marsh began to erode due to the lack of new sediments.

Intentional human modifications of the shoreline, including channel dredging and artificial shoreline stabilization, often affect shorelines that have not been

directly modified. Other indirect affects from human activities, such as creating boat wake, may impact areas sensitive to erosion; and the influence humans have on climatological changes is not well understood, but will also modify the natural driving forces of coastal erosion.

IV. ARTIFICIAL SHORELINE STABILIZATION

To combat the loss of shoreland property and to prevent damage to buildings, roads, and other landward resources, some individual property owners along Northern Virginia's tidal shoreline have used structural and nonstructural erosion control measures. Structural shoreline protection uses "hard" structures such as bulkheads, revetments, and breakwaters to armor the shoreline. Nonstructural alternatives use "soft" erosion control techniques such as slope gradation, tree setback, and vegetation planting. The two most common types of artificial shoreline stabilization structures used along Northern Virginia's tidal shoreline are wooden bulkheads and riprap revetments. There are several breakwaters and groins in the region also. Several properties have soft techniques employed in conjunction with hardened shorelines.

Bulkheads, seawalls, and revetments are structures built approximately shore parallel to separate the land from the water. Bulkheads are designed primarily to retain soil and prevent sliding of the land immediately behind them. They can provide support at the toe of a high bluff, or retention for the full height of a low bluff. Bulkheads are primarily retaining walls, however, a secondary function is they protect the shoreline against direct attack by waves and currents. The term seawall is often used interchangeably with bulkhead; however, the primary function of a seawall is to protect the shoreline against severe wave action, while their secondary function is that of a retaining wall. Revetments armor erodable bluffs or embankments, and primarily serve to absorb the energy of incoming waves.

Bulkheads and seawalls usually have a smooth surface and are constructed with treated timber, steel, or concrete. Revetments are usually composed of large quarry stones, rubble, or gabions. Gabions are rectangular baskets of steel wire mesh filled with large stones. The lack of a smooth surface of a revetment makes it more flexible to settlement and better able to absorb energy. The vertical surface of bulkheads and seawalls may reflect wave energy causing scour in front of the structure. Bulkheads, seawalls, and revetments protect only the land immediately behind them and may even exacerbate erosion of adjacent shorelines. Reflection of waves may increase erosion on either side of the structures. Downdrift shorelines may experience increased erosion if the bulkhead protects a former sediment source.

Breakwaters are often shore parallel structures; however, they are built offshore and are designed to protect the shore from wave attack, by creating a protected water area behind them. Breakwaters are often used at marinas and boat ramps to create an area of calm water, while simultaneously protecting the shore. There is often an accumulation of sediment shoreward of a breakwater. However, the reflection of waves and alteration of littoral transport may have detrimental effects beyond the immediate shoreline area.

Groins are built perpendicular to the shoreline, and are designed to trap littoral drift in order to build a beach or to retard shoreline erosion. Often, a series of groins, called a groin field, are built to affect larger areas. Groins only trap sediment on their updrift sides, and usually cause erosion of downdrift shorelines. A series of properly spaced groins are usually more effective than a single groin.

Soft control methods include slope stabilization techniques. Surface runoff can be a significant cause of erosion along the bluffed shorelines. Drainage control of surface runoff is almost always beneficial with high bluffs, and is sometimes effective with low bluffs. Slope regradation is usually effective with low bluffs, but is rarely feasible with high bluffs. Planting ground cover can help stabilize slopes, especially after regradation. Although vegetation may stabilize slopes on the shoreline, large trees very close to the land's edge may actually increase erosion. Trees often provide too much shade for slope-stabilizing vegetative ground cover to prosper. Additionally, when large trees at the head of bluffs fall, from undermining by erosion or other natural causes, they often remove a large volume of sediment with them. Creating a tree set-back line can help to stabilize bluffs. For a more detailed description of the various alternatives for shoreline protection, the reader may wish to refer to the Chesapeake Bay Shoreline Erosion Study (U.S. Army Corps of Engineers, 1990).

IV. METHODOLOGY

The tidal shorelines from Quantico to Little Falls were divided into twenty-one shoreline segments, based on jurisdictional boundaries and physiographic features. In addition, the shoreline segments were chosen to fit in a 7" x 10" rectangle, at a scale of 1:24,000. It was determined that an 8.5" x 11" format was the best size to work with, and so the maps were designed to fit in 7" x 10" rectangles to allow for borders and binding.

For each of the twenty-one segments; a reference map, a shoreline changes map, and an artificial shoreline stabilization map accompany the textual description.

Reference Maps

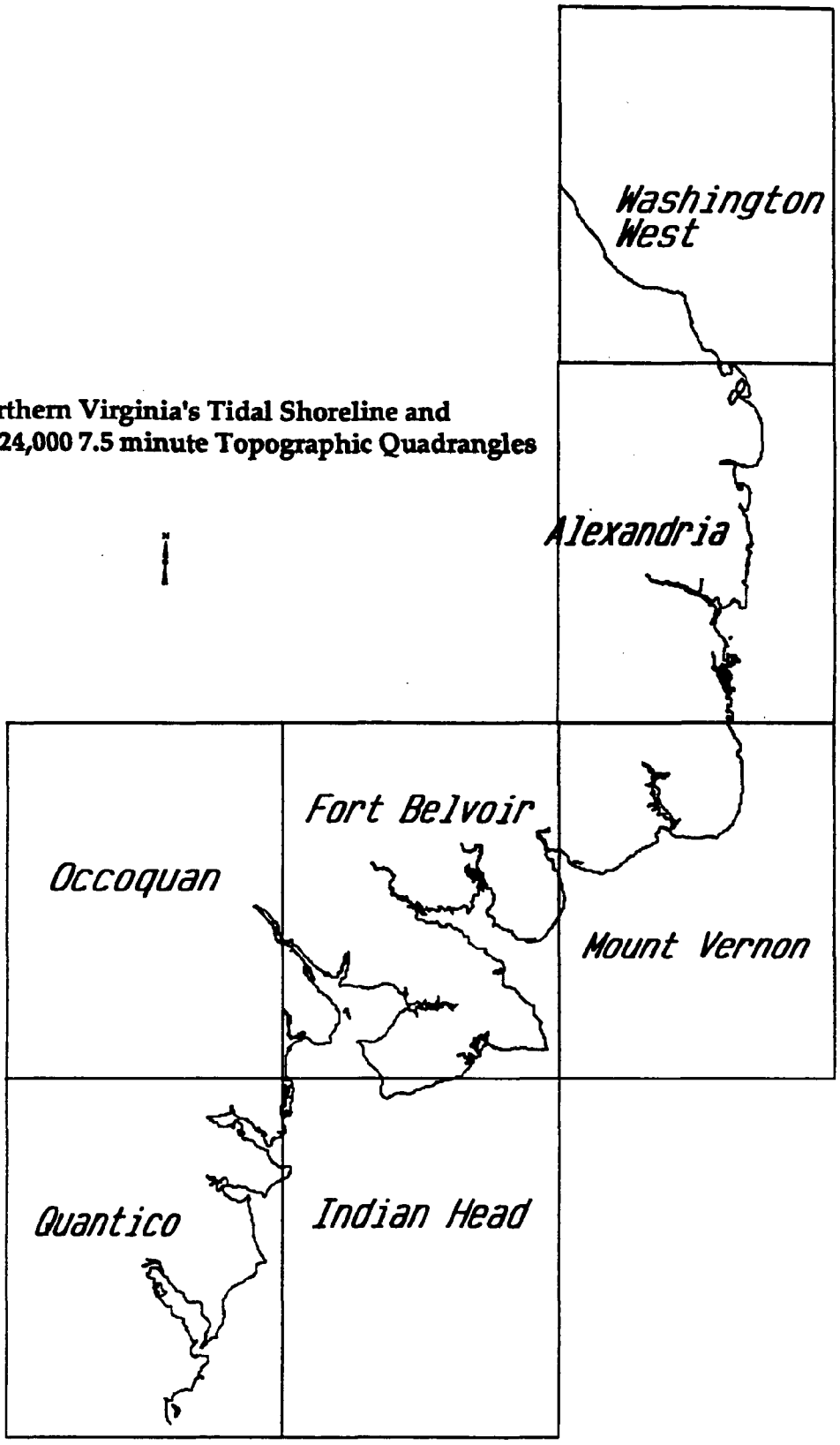
Twenty-one reference maps were made from the most recent set of United States Geological Survey 7.5 minute topographic quadrangles (USGS topo quads), that cover Northern Virginia. The seven maps used were: Alexandria (1983), Fort Belvoir (1983), Indian Head (1982), Mount Vernon (1983), Occoquan (1984), Quantico (1983), and Washington West (1983) (see Figure 2). Although these maps are all dated from the early 1980s, they are the most recent USGS topo quads available.

The twenty-one maps and shoreline segments are as follows, and as illustrated in Figures 3 and 4; they have also been included in **Appendix 1** to accompany each of the twenty-one shoreline segments:

Map 1 County Line to Shipping Point
Map 2 Shipping Point to Possum Point
Map 3 Possum Point to Cockpit Point
Map 4 Cockpit Point to Freestone Point
Map 5 Freestone Point to Mouth of Neabsco Creek
Map 6 Mouth of Neabsco Creek to Deephole Point
Map 7 Deephole Point to Occoquan River Dam
Map 8 Occoquan River Dam to Route 1 Bridge
Map 9 Route 1 Bridge to Kanes Creek
Map 10 Kanes Creek to Sandy Point
Map 11 Sandy Point to Sycamore Point
Map 12 Sycamore Point to Hallowing Point
Map 13 Hallowing Point to Pohick Bay
Map 14 Pohick Bay to Whitestone Point
Map 15 Whitestone Point to Ferry Point
Map 16 Ferry Point to Little Hunting Creek
Map 17 Little Hunting Creek to Hog Island
Map 18 Hog Island to Hunting Creek

Map 19 Hunting Creek to Four Mile Run
Map 20 Fourmile Run to Theodore Roosevelt Bridge
Map 21 Theodore Roosevelt Bridge to Little Falls

Figure 2: Northern Virginia's Tidal Shoreline and Associated USGS 1:24,000 7.5 minute Topographic Quadrangles



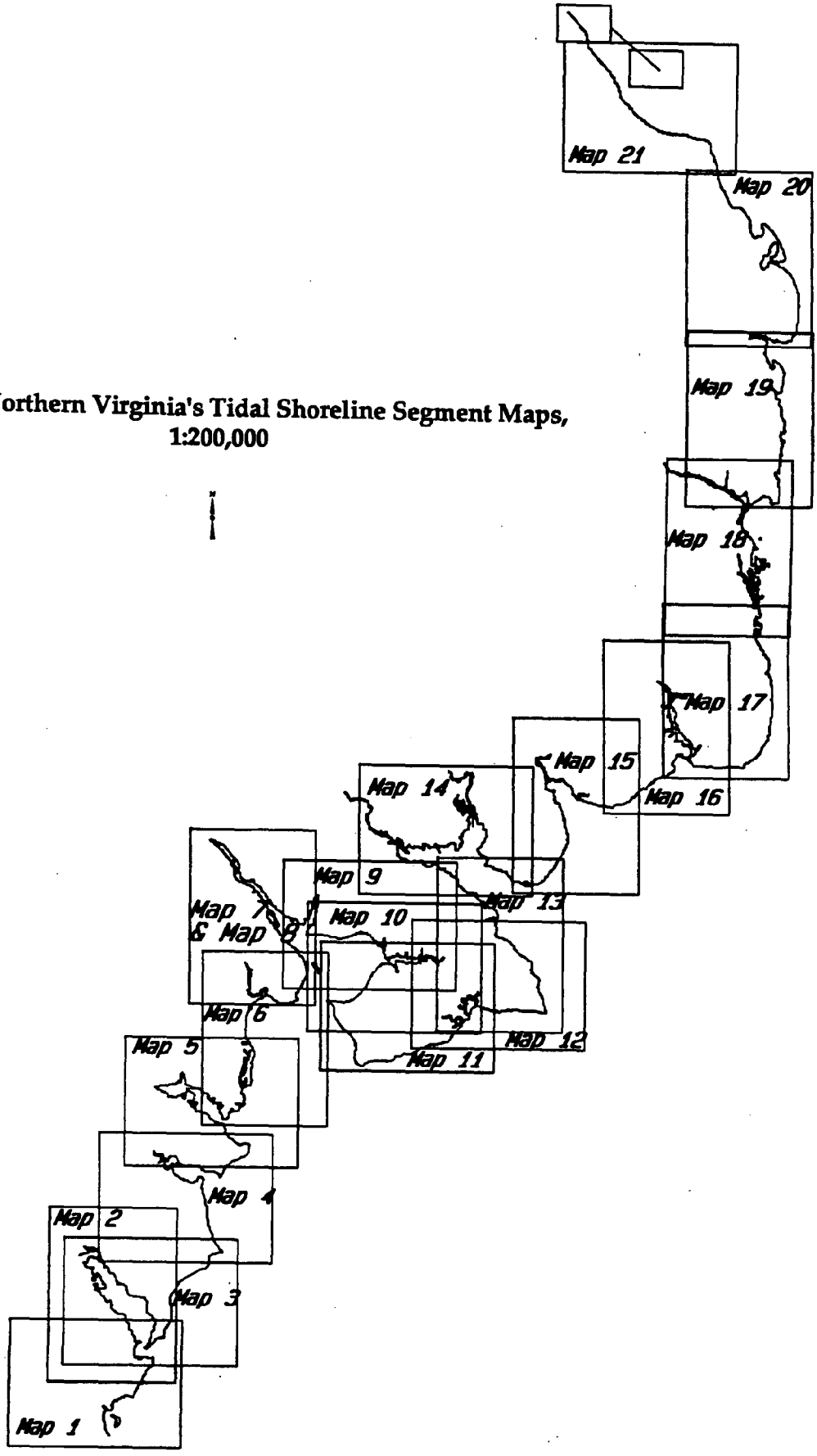
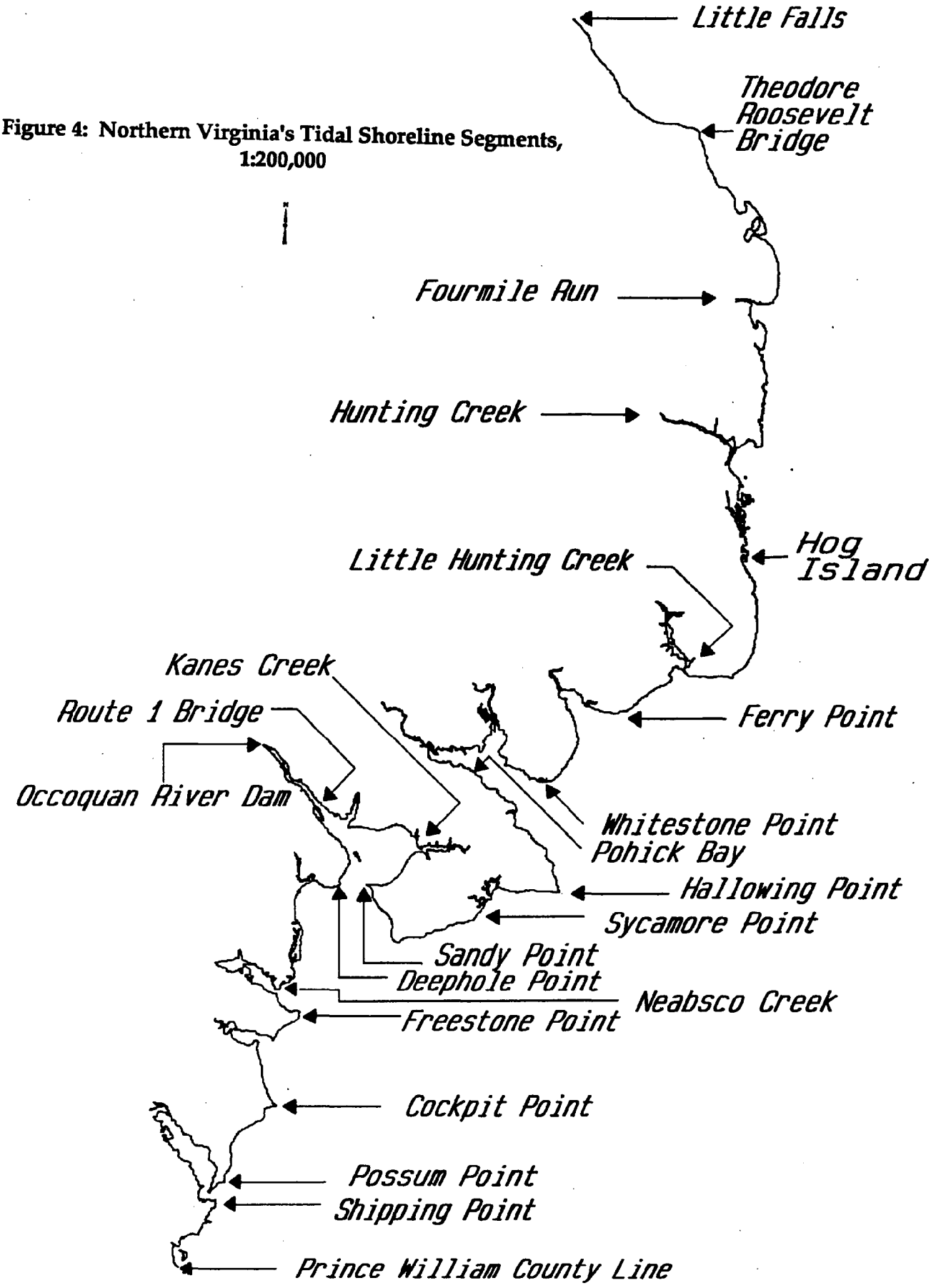


Figure 3: Northern Virginia's Tidal Shoreline Segment Maps, 1:200,000

Figure 4: Northern Virginia's Tidal Shoreline Segments, 1:200,000



Shoreline Changes Maps

The USGS topo quads have five different types of lines that represent the shoreline: (1) A solid blue line represents the high water line; (2) a light blue line represents the assumed high water line; (3) a dotted blue line represents the low water line; (4) a black line represents an artificial structure along the shoreline; and (5) a purple line represents a photo revision of an earlier shoreline.

For each of the twenty-one shoreline segments (**Appendix 1**), a shoreline changes map was also made by digitizing the high water line from two sets of mylar (stable material) USGS topo quads. The seven topo quad editions mentioned above were used as the most recent set of maps available from the USGS. The second set of maps used were the following editions: Alexandria (1971), Fort Belvoir (1965), Indian Head (1966), Mount Vernon (1966), Occoquan (1966), Quantico (1966), and Washington West (1971). The two digitized shorelines were plotted for each segment; and the areas where the shoreline eroded were shaded red, and areas where the shoreline accreted were shaded blue.

The user should be aware of the potential errors associated with the shoreline changes maps. Mylar USGS topo quads were used for digitizing, to minimize distortions associated with paper prints, and a visual comparison of the digitized shoreline plots with the mylar USGS topo quads was used, to minimize operator errors associated with the digitizing process. According to the USGS, the 1:24,000 topo maps meet National Map Accuracy Standards of +/- 40 feet; however, the positions of the shorelines on the maps were subject to interpretation. The maps were made from field survey data and aerial photo analyses. One important consideration must be emphasized: the high water line along marshes is highly variable depending on the time of year, the tide, recent storm activity, and vegetation changes. The shoreline change maps, therefore, show very high rates of change for many marsh areas that may be associated with the spatial and temporal dynamics of marshes, rather than with high rates of sediment movement.

Also, in areas with high bluffs, the shoreline change maps provide only a two-dimensional picture of erosion; the volume of sediment displaced from a cliff is not adequately represented by the horizontal shoreline change. In addition, erosion at the head of a cliff can be masked in a two dimensional analysis by the accumulation of debris at the toe of the cliff. Therefore, small changes along bluffs may be more significant than large changes in marsh areas.

The shoreline changes maps should be used in conjunction with the topographic reference maps. Asterisks have been placed on the maps adjacent to the areas of significant shoreline change. The text accompanying each map also includes estimates of the recession rates in the areas of significant erosion. The categories used are moderate (< 3 ft/yr), severe (> 3 ft/yr), and extreme (> 15 ft/yr). Because the shoreline changes were interpreted at a scale of 1" = 2000' and from

sets of maps ranging from 13 to 19 years apart, the shoreline change maps should not be used to indicate areas of slight or no change (< 1 ft/yr); slight changes may not be captured by these maps.

Due to the scale of the maps, the potential errors associated with them, and the high spatial and temporal variability of erosion rates, this information should not be used for site-specific planning purposes. On the other hand, these maps are very useful for targeting shoreline erosion priority areas for additional investigation, as well as for identifying areas requiring remedial action.

Artificial Shoreline Stabilization Maps

Artificial shoreline stabilization maps were produced for each of the shoreline segments (**Appendix 1**) . The locations and lengths of the stabilized areas are rough estimates made from examinations of aerial slides, videos and boat survey. Stabilized shoreline lengths and percentages may differ slightly from previous Shoreline Situation Reports, primarily as a result of variations in interpreting marshland along shorelines. Also, the scale of these maps is not conducive to pinpointing precise locations of artificial stabilization; however, they do provide an overview of the approximate locations and lengths of shorelines that have been stabilized.

The type of structure is indicated on the maps as follows: B = bulkhead, R = riprap, G = groin; BW = breakwater; and C = channel gabion. A rough estimate of the percent of each of the types of structures is included in the text accompanying each map.

For more detailed information on more precise locations of artificial shoreline stabilization in Northern Virginia, the user may also wish to refer to the individual parcel and property owner data base, and the aerial slides and videos that were produced in conjunction with this report. This additional information is principally available through the Northern Virginia Planning District Commission in Annandale, Virginia among various other sources.

Map Text

The textual descriptions that accompany the maps for each of the shoreline segments found in **Appendix 1** contain the following information:

- **Map Number**
- **Shoreline segment:** the names of the starting and ending locations of the shoreline covered in this segment.

- **USGS Quadrangle(s)**: the name of the United States Geological Survey 7.5 minute topographic quadrangle map that covers the area. The USGS quadrangles are based on an even 7.5 minute grid system independent of physiographic features. In several cases, quadrangle boundaries cross the shoreline segment, and therefore more than one quadrangle is listed.

- **County** or **City**: the name of the jurisdiction that the shoreline segment is part.

- **Property Maps**: the page numbers of the real estate tax assessment maps that cover the shoreline segment. Each jurisdiction has a separate mapping program, and therefore the numbering systems differ.

- **Water Body** or **Bodies**: the name of the body or bodies of water that the shoreline is adjacent to.

- **Shoreline Description**: an approximate shoreline length, and a brief description of the distinguishing features of the segment. The shoreline length measurements were made from the shorelines digitized from the recent set of USGS topo quads.

- **Erosion Situation**: the areas of cartographically identified shoreline erosion are described.

- **Artificial Stabilization**: the approximate length and percent (%) of shoreline that has been artificially stabilized, and a brief description of the type of stabilization.

V. SUMMARY

There are a total of 156.6 miles of tidal shoreline included in this study for Prince William, Fairfax, and Arlington Counties and the City of Alexandria (see Table 1); 45.3 miles of the tidal shoreline lies directly on the Potomac River, and the remainder along tributaries, including the Occoquan River and several large creeks and bays. Overall, 20 % of the shoreline has been artificially stabilized with 32.0 miles of hard structures: Prince William County is 47.6 miles in length and has 8.7 miles of artificial shoreline stabilization structures. Fairfax has the most tidal shoreline in Northern Virginia (86.9 miles), and the most artificial stabilization (13.3 miles), but the smallest percent of shoreline stabilized (15%). The City of Alexandria has the shortest shoreline length (8.8 miles), with the largest percent stabilized (58%, or 5.1 miles). Arlington County has 13.3 miles of tidal shoreline, with 4.9 miles of hardened shoreline (37%).

The shoreline rate of change maps present the differences in shorelines on USGS topo quads, between the mid 1960s and the 1980s. These maps should be used in conjunction with the topographic reference maps to assist in interpretation. Large areas of shoreline change at the head of creeks are probably due to vegetation changes and meandering channels, rather than large sediment fluxes. In addition, there are several areas where the shoreline has changed due to human intervention, such as the channelization of Four Mile Run. The areas that should be periodically monitored are the steadily eroding bluffs. While the two dimensional changes may appear smaller for these areas than for low-lying coasts, the total volume of sediment input into the adjacent water body from the eroding cliffs is often significant.

The shoreline changes maps from **Appendix 1** show that there are two areas along the Potomac River that have undergone extreme rates of erosion (> 15 ft/yr); these are the airfield at Quantico, and Dyke Marsh to the south of Little Hunting Creek. There are other areas that have apparently undergone significant shoreline changes at the heads of the large tidal creeks and in other marsh areas; however, these shifting shorelines are probably not due to large sediment fluxes. According to the shoreline change maps many areas throughout the Northern Virginia study area have had severe (> 3 ft/yr) and moderate (< 3 ft/yr) erosion. The artificial shoreline stabilization maps from **Appendix 1** show approximate locations of hardened shoreline. As indicated in the maps and throughout the text, 59% of the stabilized shoreline is armored with riprap, and 36% with bulkhead. The remaining 5% of the shoreline has breakwaters, groins, and channel gabion. In the 1976 and 1979 Shoreline Situation Reports (ROGERS, *et al.*, 1976, and OWEN *et al.*, 1979), 13% of the 144.5 miles of tidal shoreline studied in Northern Virginia were armored; or 19.5 miles. Although the techniques used to measure the shoreline length and length of artificial shoreline stabilization structures were different for this study, and the study area differed slightly, it is

County or City	Shoreline Length (miles)	Artificial Stabilization (miles)	%
Fairfax	86.9	13.3	15%
Prince William	47.6	8.7	18%
Arlington	13.3	4.9	37%
City of Alexandria	8.8	5.1	58%
Total	**156.6**	**32.0**	**20%**
Potomac River	45.3		

TABLE 1: Summary of Tidal Shoreline and Artificial Stabilizationfor Fairfax, Prince William and Arlington Counties, and the City of Alexandria (as detailed below).

Map	Segment	County or City	Water Body	Shoreline Length (miles)	Artificial Stabilization (miles)	%
1	County Line to Shipping Point	PW	Potomac River	3.7	1.7	47%
2	Shipping Point to Possum Point	PW	Potomac River Quantico Creek *total*	0.9 9.3 10.2	0.4	4%
3	Possum Point to Cockpit Point	PW	Potomac River	2.5	1.4	55%
4	Cockpit Point to Freestone Point	PW	Potomac River Powells Creek *total*	2.9 3.7 6.6	0.6	10%
5	Freestone Point to Neabsco Creek	PW	Potomac River Neabsco Creek *total*	1.0 6.0 7.0	0.3	5%
6	Neabsco Creek to Deephole Point	PW	Occoquan Bay Farm Creek Marumsco Creek unnamed tributaries *total*	4.1 3.2 3.4 0.9 11.6	1.8	15%
7	Deephole Point to Occoquan River Dam	PW	Belmont Bay Occoquan River *total*	1.6 4.4 6.0	2.4	40%

TABLE 1(a): Tidal Shoreline and Artificial Stabilization for Prince William County.

Map	Segment	County or City	Water Body	Shoreline Length (miles)	Artificial Stabilization (miles)	%
8	Occoquan River Dam to Route 1 Bridge	FX	Occoquan River	2.1	0.2	8%
9	Route 1 Bridge to Kanes Creek	FX	Occoquan River Massey Creek Belmont Bay unnamed tributary *total*	1.2 2.6 2.1 0.9 6.8	1.7	25%
10	Kanes Creek to Sandy Point	FX	Kanes Creek Belmont Bay *total*	5.0 1.7 6.6	0.0	0%
11	Sandy Point to Sycamore Point	FX	Occoquan Bay Potomac River *total*	1.7 2.0 3.7	0.6	16%
12	Sycamore Point to Hallowing Point	FX	Potomac River unnamed tributaries *total*	2.8 5.2 8.0	1.2	15%
13	Hallowing Point to Pohick Bay	FX	Potomac River Gunston Cove unnamed tributaries *total*	2.1 2.1 0.5 4.7	0.5	12%
14	Pohick Bay to Whitestone Point	FX	Pohick Bay Pohick Creek Accotink Bay Accotink Creek Gunston Cove *total*	4.4 1.8 2.1 6.4 1.8 16.6	0.6	4%
15	Whitestone Point to Ferry Point	FX	Potomac Bay Dogue Creek Whitestone Point Basin Mount Vernon Yacht Basin *total*	1.9 4.9 0.6 0.7 8.1	3.3	41%
16	Ferry Point to Little Hunting Creek	FX	Potomac River Little Hunting Creek *total*	1.8 9.2 11	1.7	15%
17	Little Hunting Creek to Hog Island	FX	Potomac River	4.4	2.0	46%
18	Hog Island to Hunting Creek	FX	Potomac River Hunting Creek unnamed tributaries *total*	4.4 0.9 9.6 14.9	1.4	9%

TABLE 1(b): Tidal Shoreline and Artificial Stabilization for Fairfax County.

Map	Segment	County or City	Water Body	Shoreline Length (miles)	Artificial Stabilization (miles)	%
19	Hunting Creek to Four Mile Run	AL	Hooff Run	0.7		
			Hunting Creek	1.2		
			Potomac River	6.6		
			Four Mile Run	0.3		
			total	**8.8**	5.1	58%
20	Four Mile Run to Theodore Roosevelt Bridge	AR	Four Mile Run	0.5		
			Potomac River	3.9		
			Roaches Run	2.2		
			Boundary Lagoon	1.6		
			Little River	0.1		
			total	**8.3**	3.9	47%
21	Theodore Roosevelt Bridge to Little River	AR	Little River	0.6		
			Potomac River	4.4		
			total	**5.0**	1.0	21%

TABLE 1(c): Tidal Shoreline and Artificial Stabilization for Arlington County and the City of Alexandria.

nonetheless apparent that more of Northern Virginia's tidal shoreline is armored in 1992: 20% of 156.6 miles, or 32.1 miles (approximately 12.6 more miles than in the late 1970s).

Due to the scale of the maps, the potential errors associated with them, and the high spatial and temporal variability of erosion rates this information should not be used for site-specific planning purposes. However, these maps are useful for targeting shoreline erosion priority areas for additional investigation. Future work should include a three-dimensional analysis of sediment transport from bluffs, as well as a photogrammetric two-dimensional analysis of rates of shoreline change. A more detailed study of the effectiveness of artificial stabilization structures should also be done. Finally, critical areas should be identified that consider the effect of land use, the proximity of buildings and roads to the shoreline, the physiographic and topographic features of the coast, and the relative rate of shoreline change.

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MAP 1

Shoreline Segment: Prince William County Line to Shipping Point

USGS Quadrangle: Quantico

County: Prince William

Property Maps: 1S, 1N, 2S

Water Body: Potomac River

Shoreline Description:
There are approximately 3.7 miles of shoreline on the Potomac River from the Prince William County line to Shipping Point, including the shoreline of Chopawamsic Island which is roughly 0.8 mile in circumference.

The southern boundary of this shoreline segment is the county line between Prince William and Stafford counties. The mouth of Chopawamsic Creek was at the county line prior to the 1930s construction of the U.S. Marine Corps (Quantico) airfield using artificial fill. The county line now runs across the airfield and the mouth of Chopawamsic Creek has been diverted to the south.

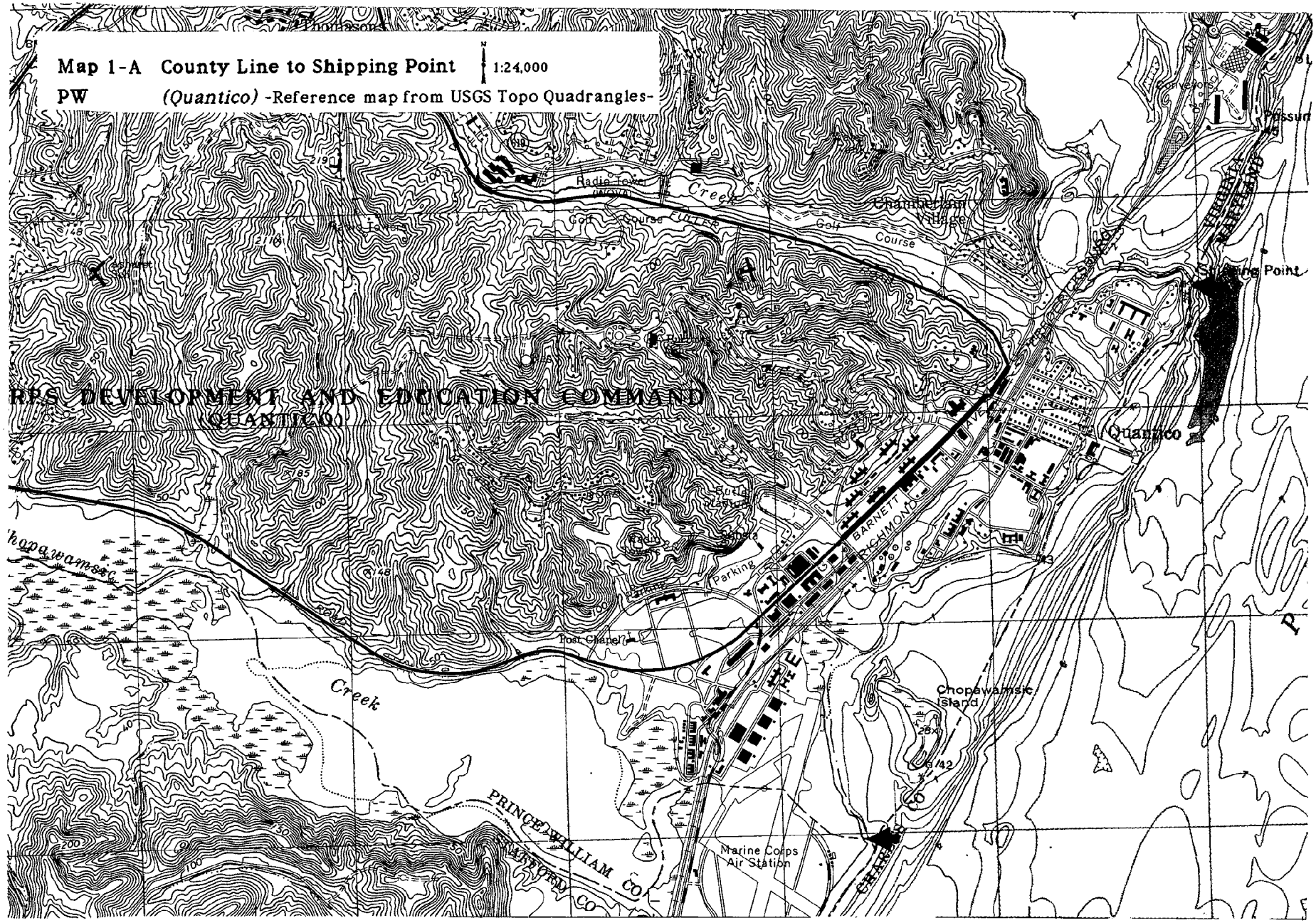
The entire shoreline in this segment is along the U.S. Marine Corps Development and Education Command Center (Quantico). The town of Quantico is located behind the large boat dock. There are two large piers and numerous boat slips at the boat dock, and there are two smaller docks on Chopawamsic Island.

Erosion Situation:
The shoreline changes map shows that extreme (> 15 ft/yr) erosion has occurred in this segment along the Quantico airfield shoreline. The map also shows that moderate (< 3 ft/yr) erosion occurred on Chopawamsic Island and south of Shipping Point. According to the Rogers *et al.*, 1976, the house at the northern end of Chopawamsic Island is endangered by bluff erosion.

Artificial Stabilization:
Overall, 47% of the shoreline in this segment has been artificially stabilized with 1.7 miles of riprap (65%) and bulkhead (35%). There is some riprap along the airfield and along the waterfront adjacent to the Quantico Boat Dock, where there is bulkheading. There is also some bulkheading on Chopawamsic Island, which Rogers *et al.*, 1976, indicated is totally ineffective.

Map 1-A County Line to Shipping Point 1:24,000

PW *(Quantico)* -Reference map from USGS Topo Quadrangles-



1:24,000

MAP 1-B
Prince William County Line to Shipping Point

1966 Shoreline ————————

1983 Shoreline ————————

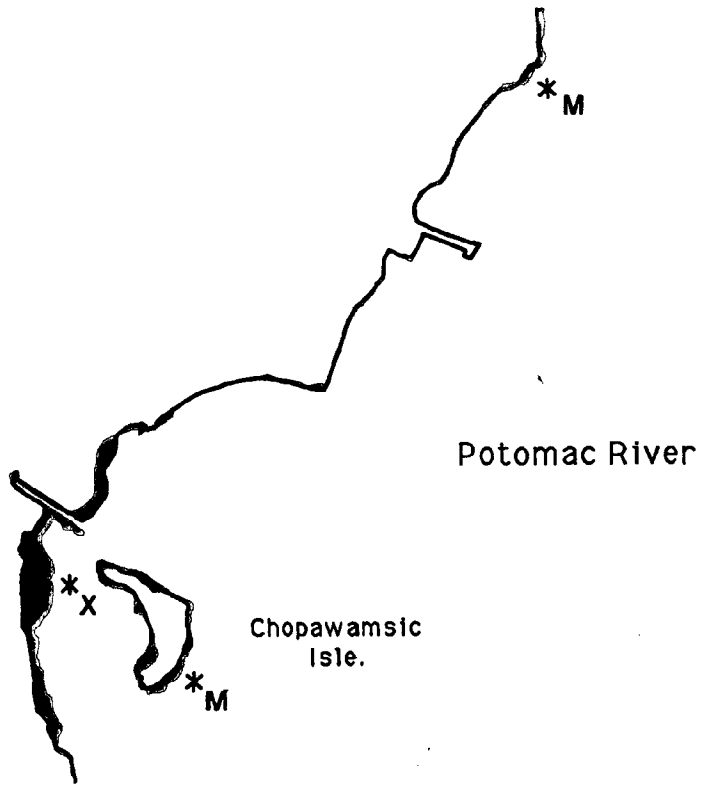
SHORELINE EROSION ■

SHORELINE ACCRETION ■

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



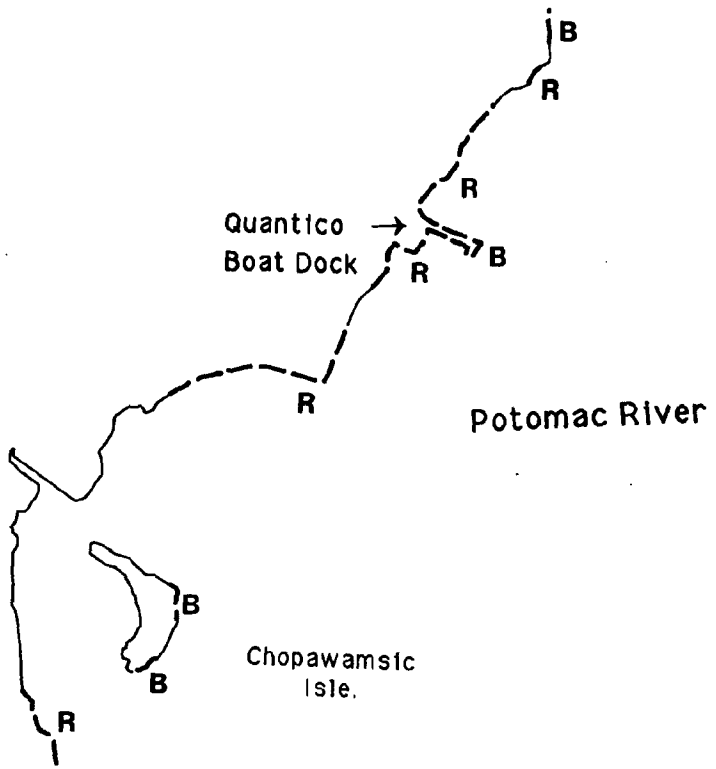
MAP 1-C
Prince William County Line to Shipping Point

1:24,000

Artificial Shoreline Stabilization ---------

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion



MAP 2

Shoreline Segment: Shipping Point to Possum Point

USGS Quadrangle: Quantico

County: Prince William

Property Maps: 2S, 2N, 5S, 6S, 11S, 6N, 5N

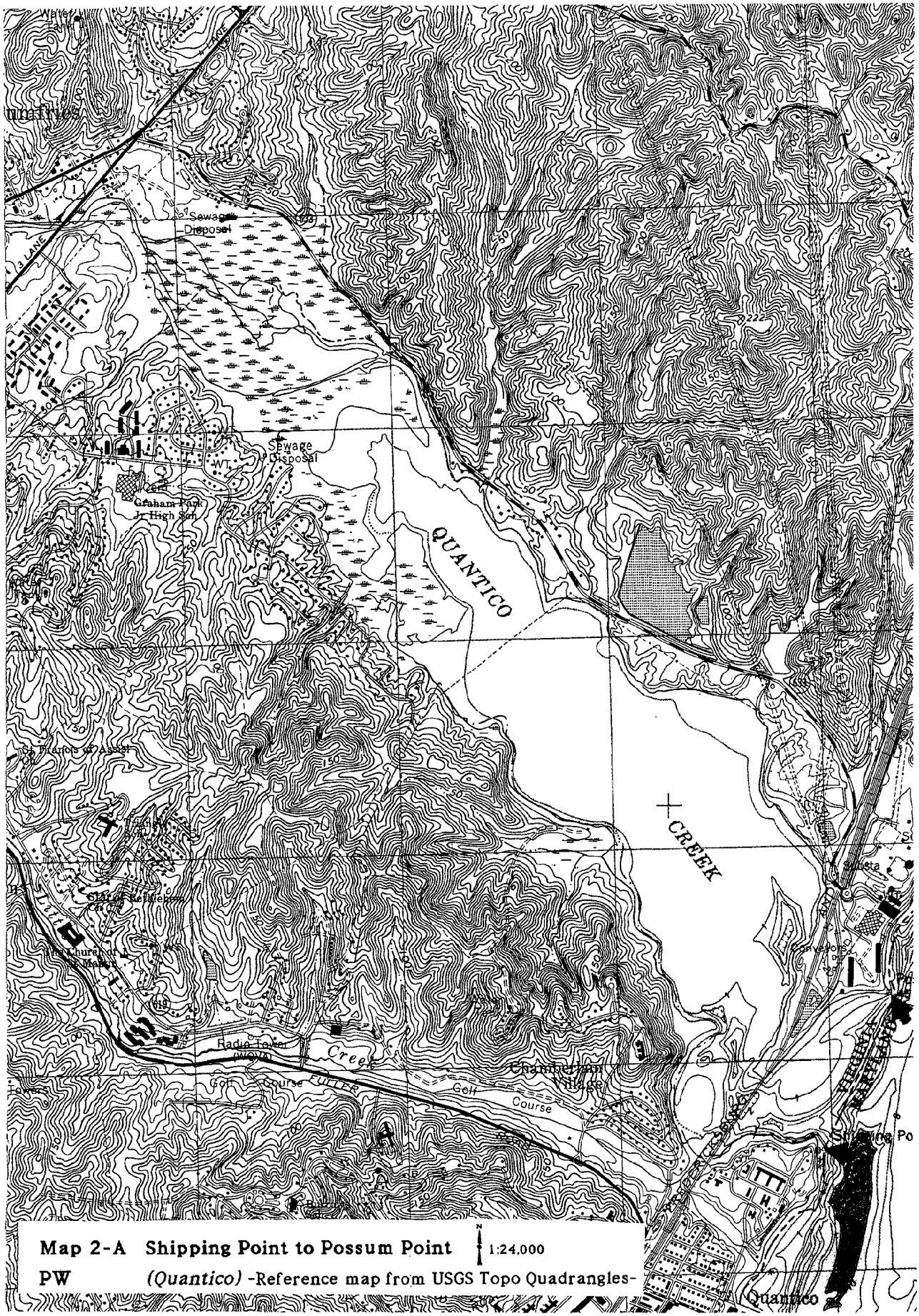
Water Body: Potomac River
Quantico Creek

Shoreline Description:
There are 10.2 miles of shoreline from Shipping Point to Possum Point. The Richmond, Fredricksburg, and Potomac Railroad bridge crosses at the mouth of the creek. The 0.9 mile of the shoreline is on the Potomac side of the railroad bridge, and the remaining 9.3 miles of shoreline are on Quantico Creek.

The 2.5 miles of shoreline to the northwest of Shipping Point is along the U.S. Marine Corps Development and Education Command Center (Quantico). The Town of Dumfries is located near the limit of tidal influence along Quantico Creek. Graham Park Shores residential area is located on the south side of the creek and a small residential area is located along Possum Point Road on the north side of the creek. There are several private piers in the residential areas. There are two sewage disposal areas behind marshes along Quantico Creek, one in Graham Park Shores, and one near the Town of Dumfries. The VEPCO Power Plant occupies the area around Possum Point. Two outlet pipes empty into Quantico Creek from the power substation.

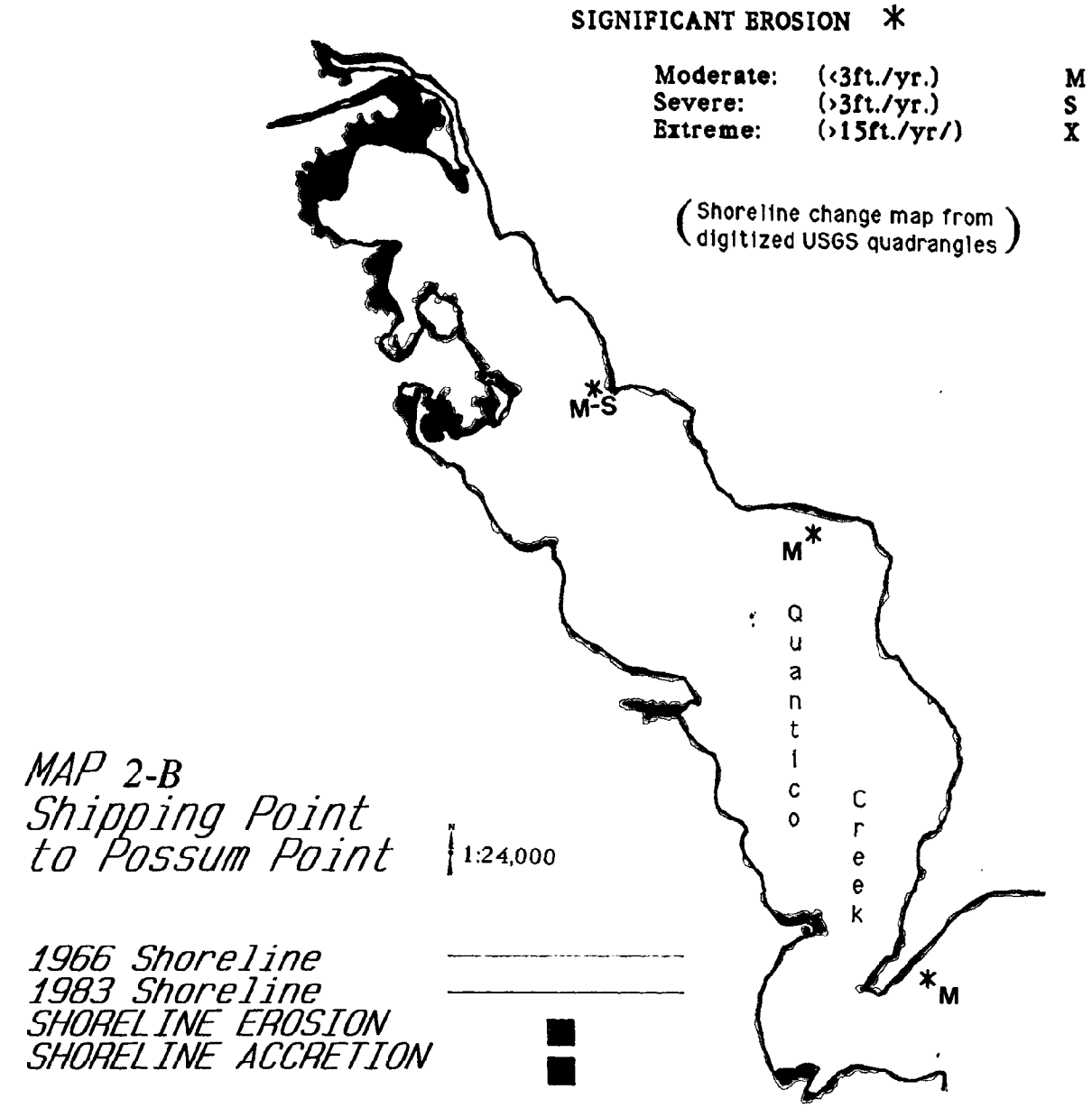
Erosion Situation:
The shoreline changes map shows erosion and accretion along the marshes in Quantico Creek; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes. Some moderate (<3 ft/yr) to severe (>3 ft/yr) bluff erosion has occurred on the north side of Quantico Creek and to the south of Possum Point.

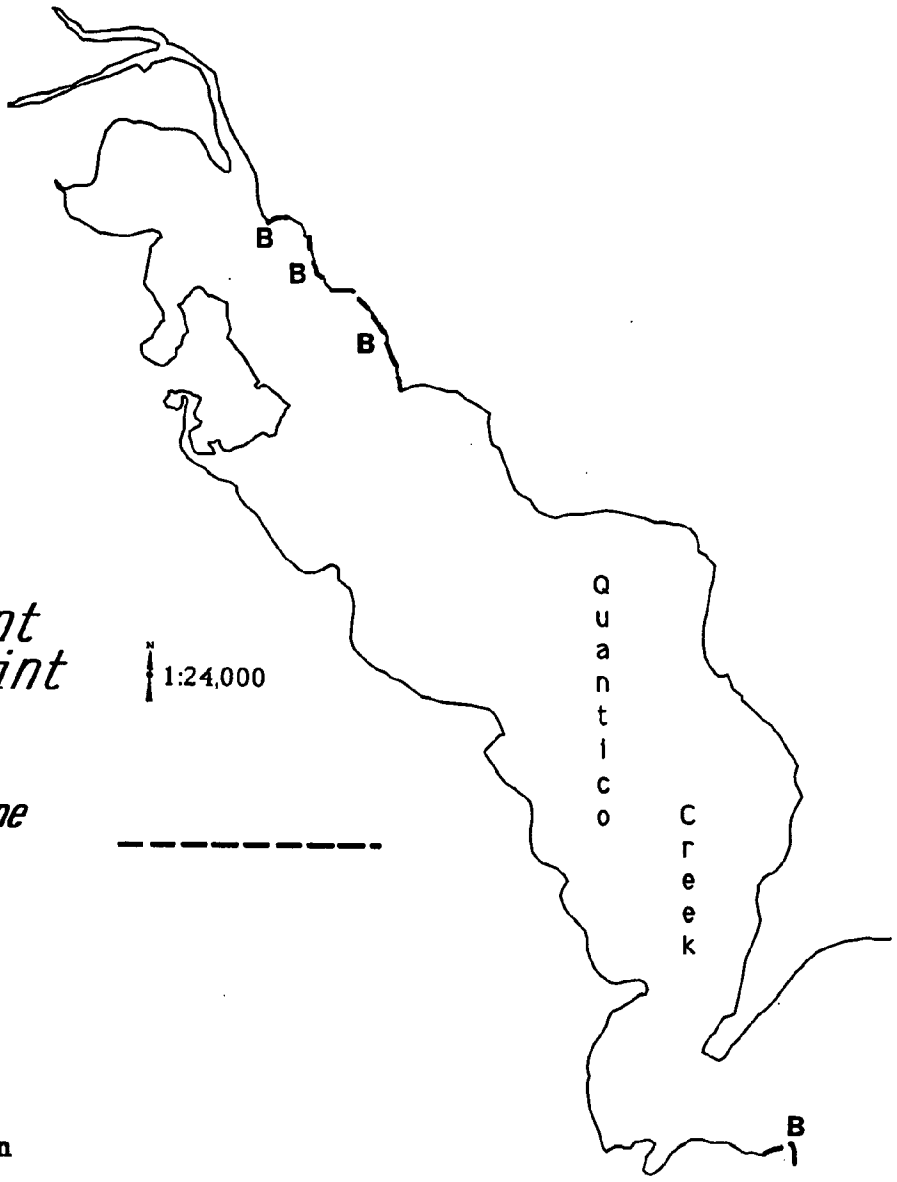
Artificial Stabilization:
Only 4% of the total shoreline in this segment has been artificially stabilized with .4 miles of bulkhead at Shipping Point and the residential area on the north side of Quantico Creek. There are some gaps between protected properties in the residential areas.



Map 2-A Shipping Point to Possum Point 1:24,000

PW *(Quantico)* -Reference map from USGS Topo Quadrangles-


SIGNIFICANT EROSION *
Moderate: (<3ft./yr.) M
Severe: (>3ft./yr.) S
Extreme: (>15ft./yr/) X
(Shoreline change map from digitized USGS quadrangles)
M-S*
M*
Quantico Creek
*M
MAP 2-B
Shipping Point
to Possum Point
1:24,000
1966 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION



MAP 2-C
Shipping Point to Possum Point

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 3

Shoreline Segment: Possum Point to Cockpit Point

USGS Quadrangle: Quantico

County: Prince William

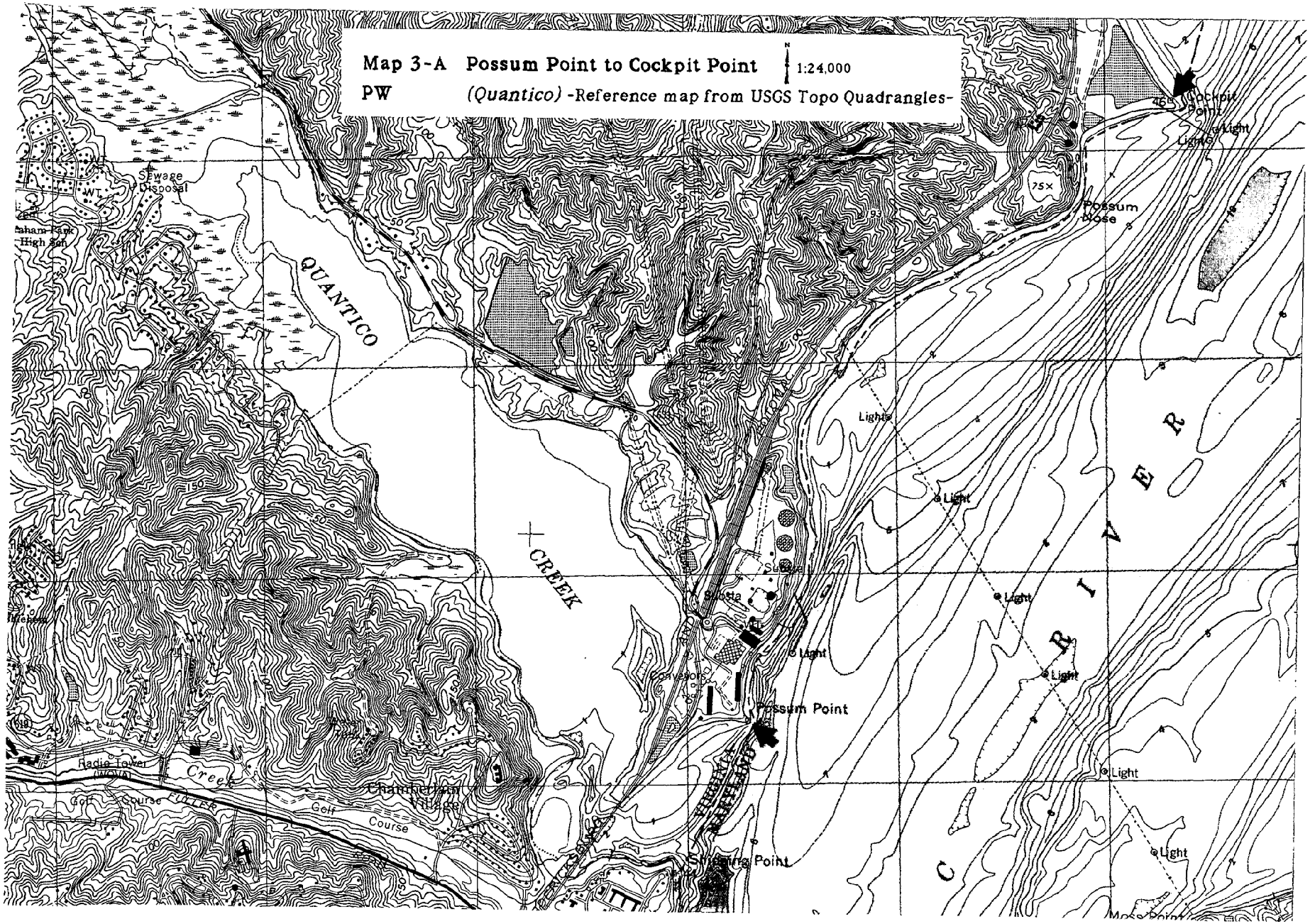
Property Maps: 2N, 5S, 4S, 4N

Water Body: Potomac River

Shoreline Description:
There are 2.5 miles of shoreline along the Potomac River from Possum Point to Cockpit Point. The VEPCO Power Plant occupies the area around Possum Point. There is a large pier at the plant. The remainder of the segment is along the Cockpit Point Industrial Park, but is largely undeveloped. The Richmond, Fredricksburg, and Potomac Railroad is close to the shore along this segment and limits shorelands access.

Erosion Situation:
The shoreline changes map shows that some moderate (< 3 ft/yr) erosion has occurred along several bluffs between Possum Point and Possum Nose.

Artificial Stabilization:
Overall, 55% of the shoreline in this segment has been artificially stabilized with 1.4 miles of bulkhead (15%) and riprap (85%). There is some bulkhead around the pier at the substation site north of Possum Point and riprap extending in both directions. There is more riprap to the north near Possum Nose, much of which is old and washed out.


Map 3-A Possum Point to Cockpit Point
1:24,000
PW (Quantico) -Reference map from USGS Topo Quadrangles-
Cockpit Point
Light
Possum Nose
Sewage Disposal
QUANTICO
CREEK
Light
Light
Light
Light
Light
Light
Light
Substa
Substa
Conveyors
Possum Point
Shipping Point
Radio Tower
Golf Course
Golf Course
Chamberlain Village
Creek
RIVER
Moss Point

MAP 3-B
Possum Point to Cockpit Point

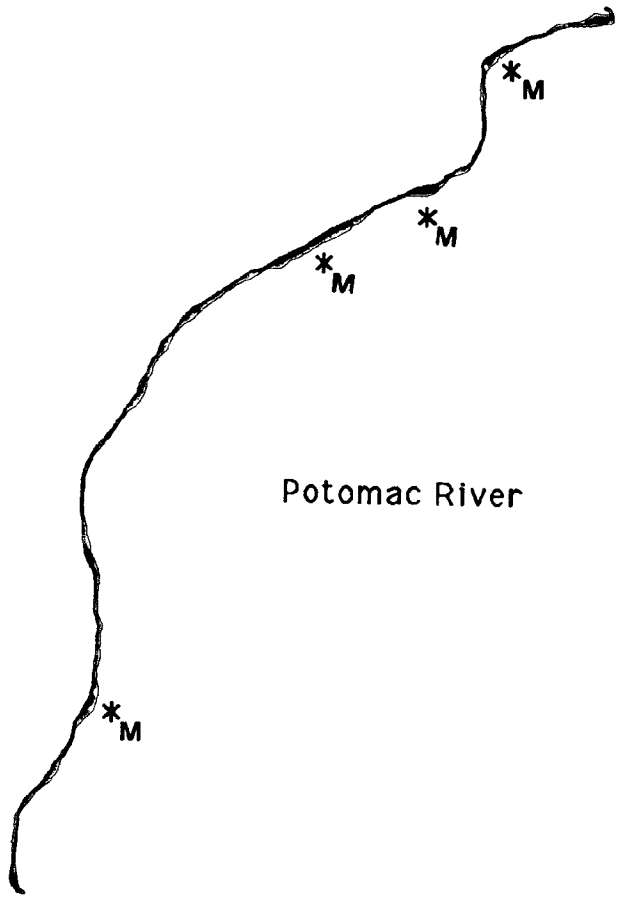
1:24,000

1966 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



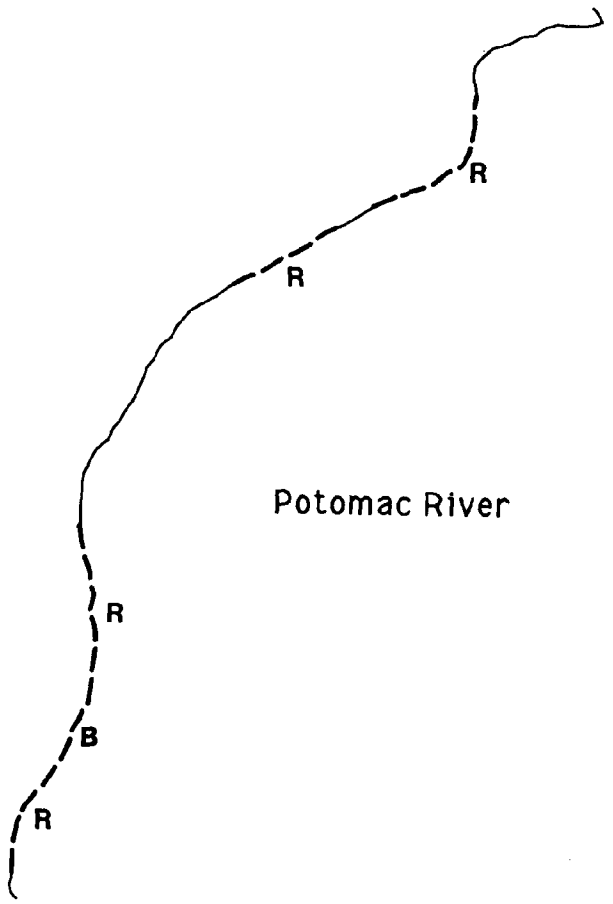
MAP 3-C
Possum Point to Cockpit Point

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion



MAP 4

Shoreline Segment: Cockpit Point to Freestone Point

USGS Quadrangles: Quantico
Indian Head

County: Prince William

Property Maps: 4N, 9S, 9N, 14S, 15S, 13S

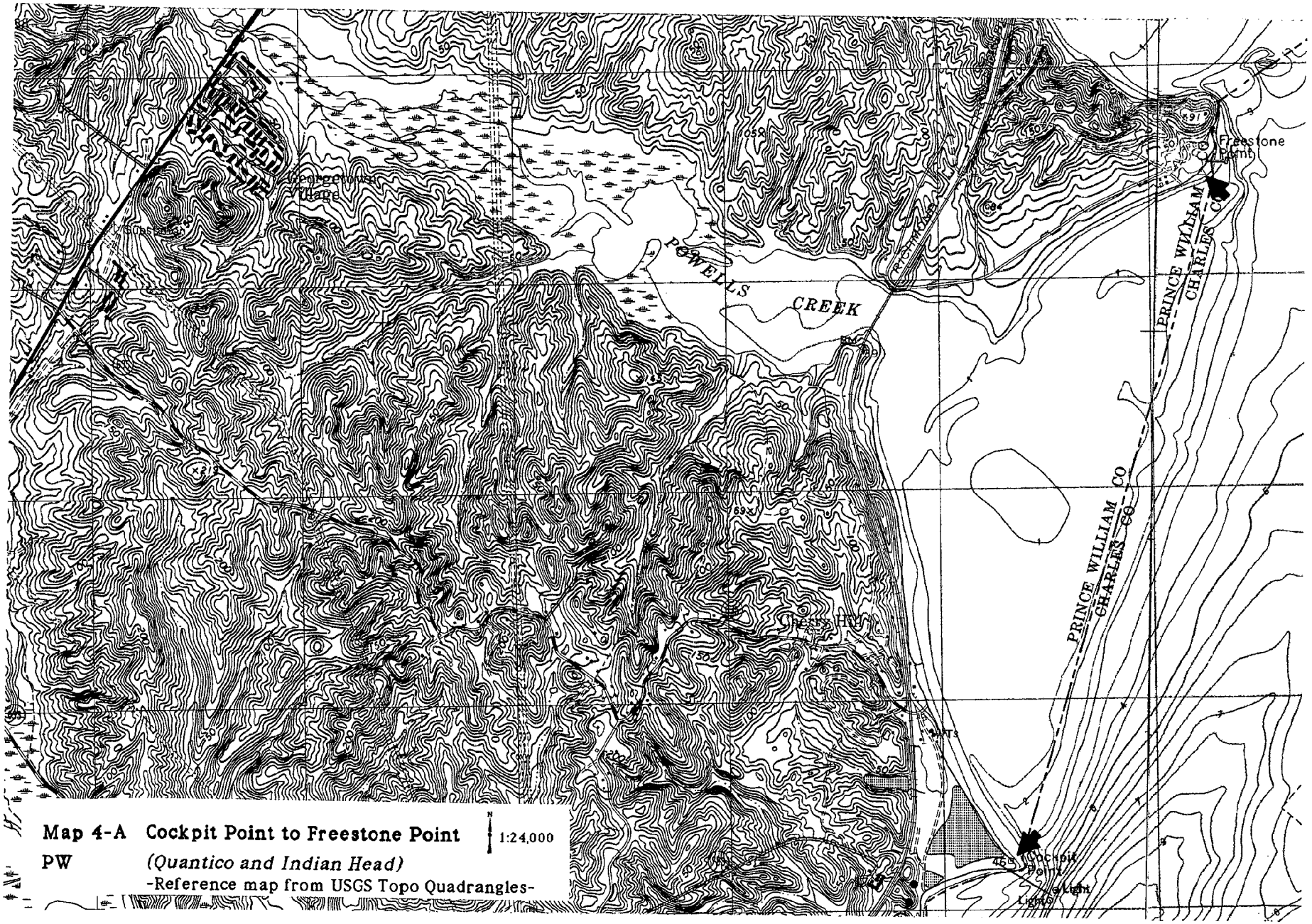
Water Bodies: Potomac River
Powells Creek

Shoreline Description:
There are 6.6 miles of shoreline from Cockpit Point to Freestone Point. The Richmond, Fredricksburg, and Potomac Railroad bridge crosses approximately at the mouth of Powells Creek. There are 2.9 miles of shoreline along the Potomac River, and 3.7 miles of shoreline along Powells Creek.

The land around Cockpit Point is part of the Cockpit Point Industrial Park. There is a small residential area at Cherry Hill, but most of the land between Cockpit Point and the mouth of Powells Creek is undeveloped. The Richmond, Fredricksburg, and Potomac Railroad is very close to the shoreline near Cherry Hill. Most of the land around Powells Creek is wooded and undeveloped except for a residential complex near the limit of tidal influence, Georgetown Village. The shoreline along the Potomac to the north of Powells Creek is now part of the newly developed Leesylvania State Park. There is a new boat ramp at the park.

Erosion Situation:
The shoreline changes map shows that moderate (< 3 ft/yr) erosion has occurred to the north of Cockpit Point, along bluffs on the south side of the mouth of Powells Creek, to the north of Powells Creek, and to the south of Freestone Point. The map also shows that many shoreline changes have occurred along the marsh shorelines of Powells Creek; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes.

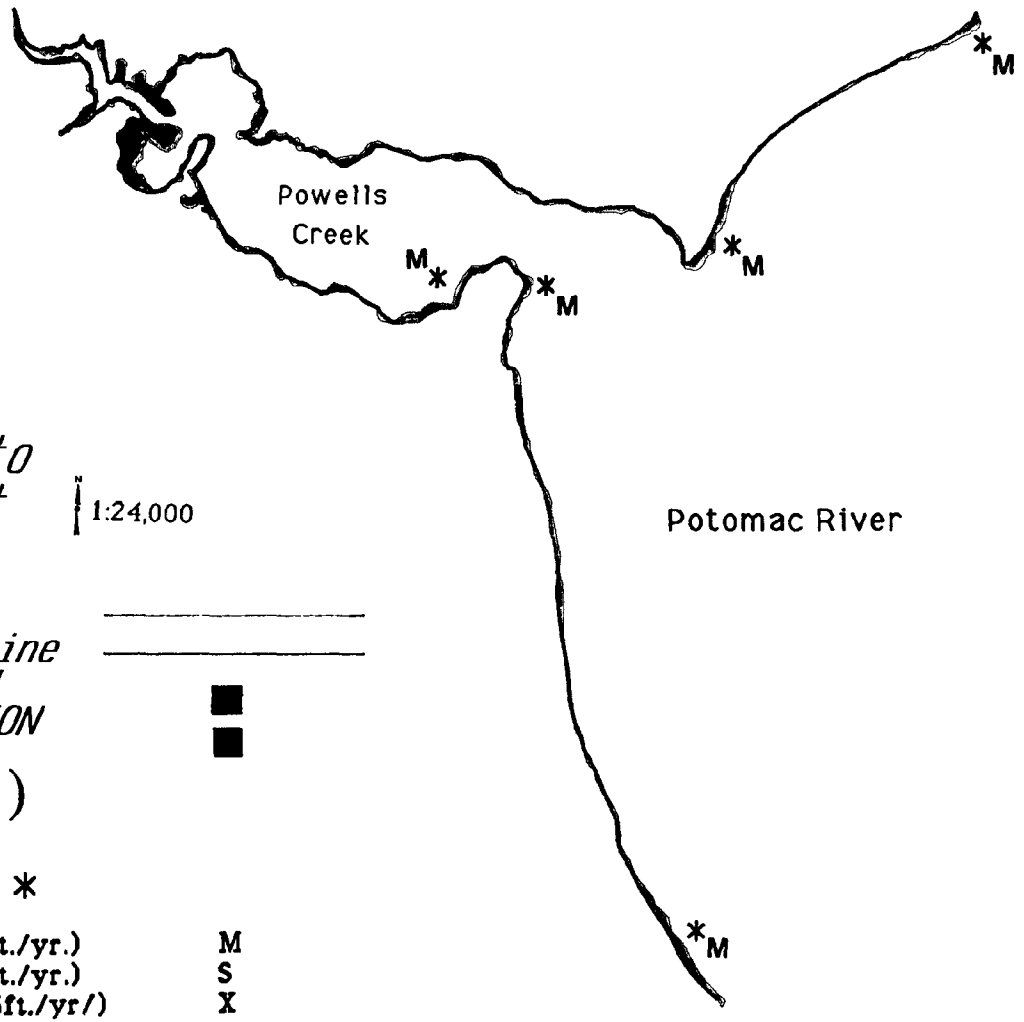
Artificial Stabilization:
Only 10% of the shoreline in this segment is artificially stabilized with .6 mile of structures. There is a single groin (5%) in the Cherry Hill area that Rogers *et al.*, 1976, indicated is effective. There is some riprap around the north side of the railroad bridge and to the south of Freestone Point. Nearly 20% of the shoreline armoring is with riprap and 75% is with breakwaters. The recent renovations of Leesylvania State Park included a new boat launching facility which has some bulkhead and is protected by breakwaters. Additional breakwaters were built around the north side of the entrance to Powells creek.



Map 4-A **Cockpit Point to Freestone Point** N 1:24,000

PW *(Quantico and Indian Head)*

-Reference map from USGS Topo Quadrangles-



MAP 4-B
Cockpit Point to
Freestone Point

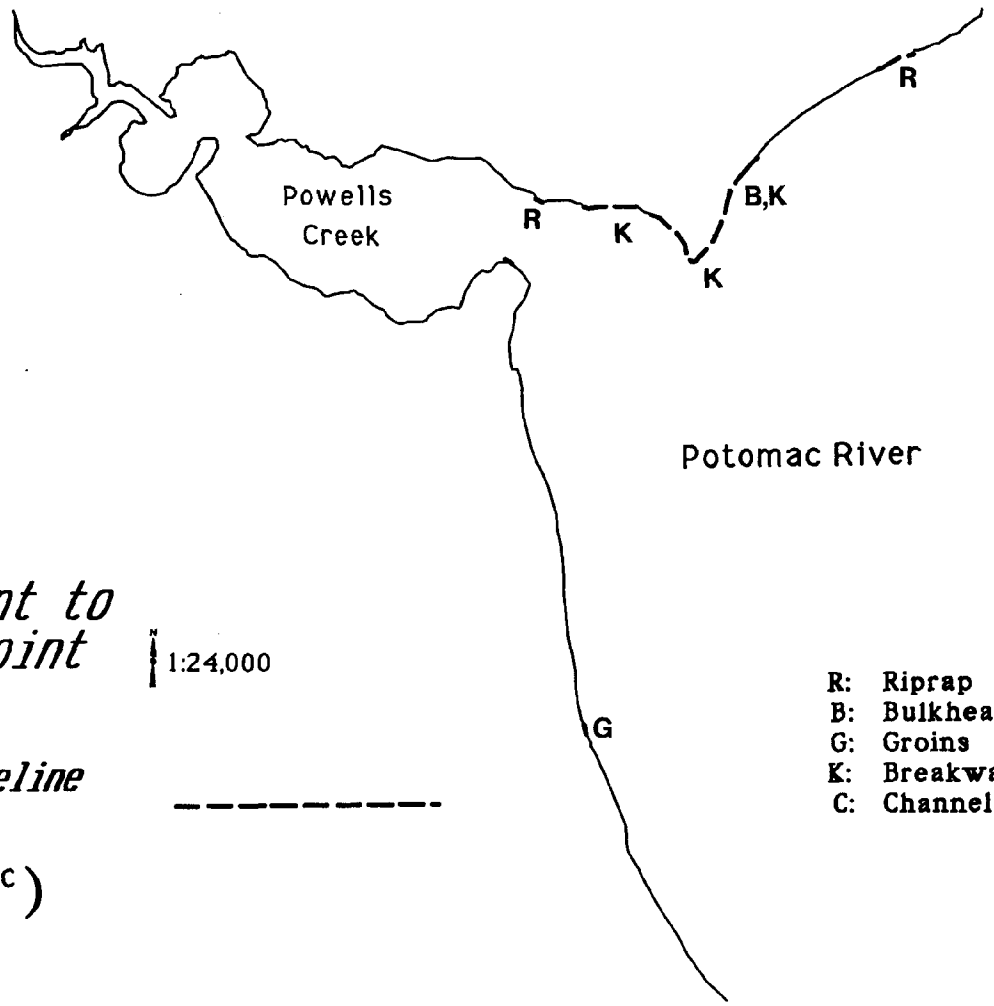
1:24,000

1966 Shoreline
1982, 1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



MAP 4-C
Cockpit Point to
Freestone Point

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 5

Shoreline Segment: Freestone Point to Mouth of Neabsco Creek

USGS Quadrangles: Quantico
Indian Head

County: Prince William

Property Maps: 13S, 14S, 14N, 20S

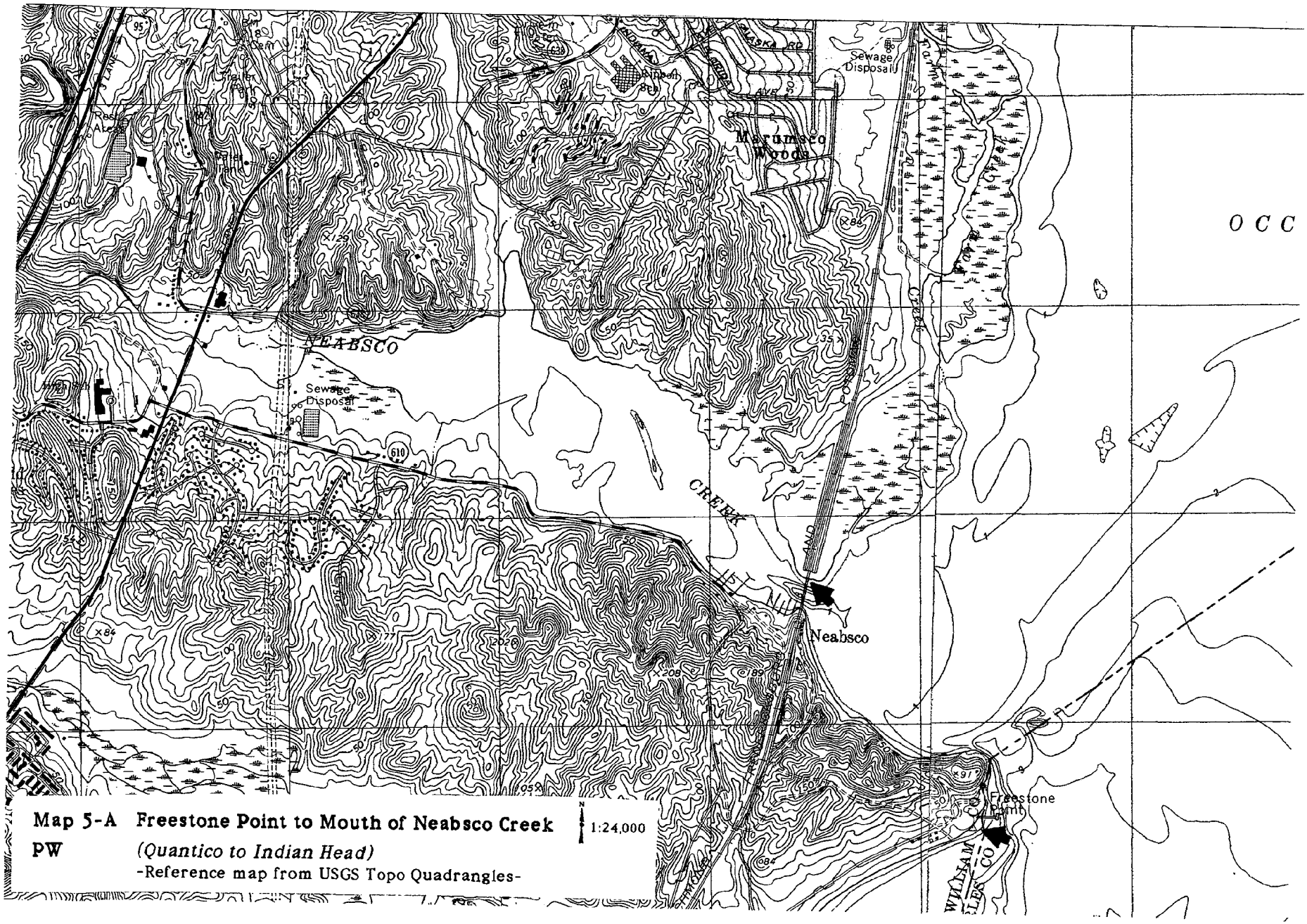
Water Body: Potomac River
Neabsco Creek

Shoreline Description:
There are 7.0 miles of shoreline from Freestone Point to the northern side of the mouth of Neabsco Creek. The Richmond, Fredricksburg, and Potomac Railroad bridge crosses approximately at the mouth of Neabsco Creek. Approximately 1.0 mile of this segment is along the Potomac River, and the remaining 6.0 miles of shoreline are along Neabsco Creek.

The land around Freestone Point is all part of the newly developed Leesylvania State Park. There is a large fishing pier at Freestone Point. There are several commercial marinas with numerous piers and several boat ramps at Neabsco at the southern side of the mouth of Neabsco Creek. There is a sewage disposal area behind the marsh at the head of the creek.

Erosion Situation:
The shoreline changes map shows that shoreline changes have occurred along the marsh shorelines of Neabsco Creek; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes. The map also shows moderate (< 3 ft/yr) bluff erosion around Neabsco to the south of the railroad bridge, and on the north side of Freestone Point.

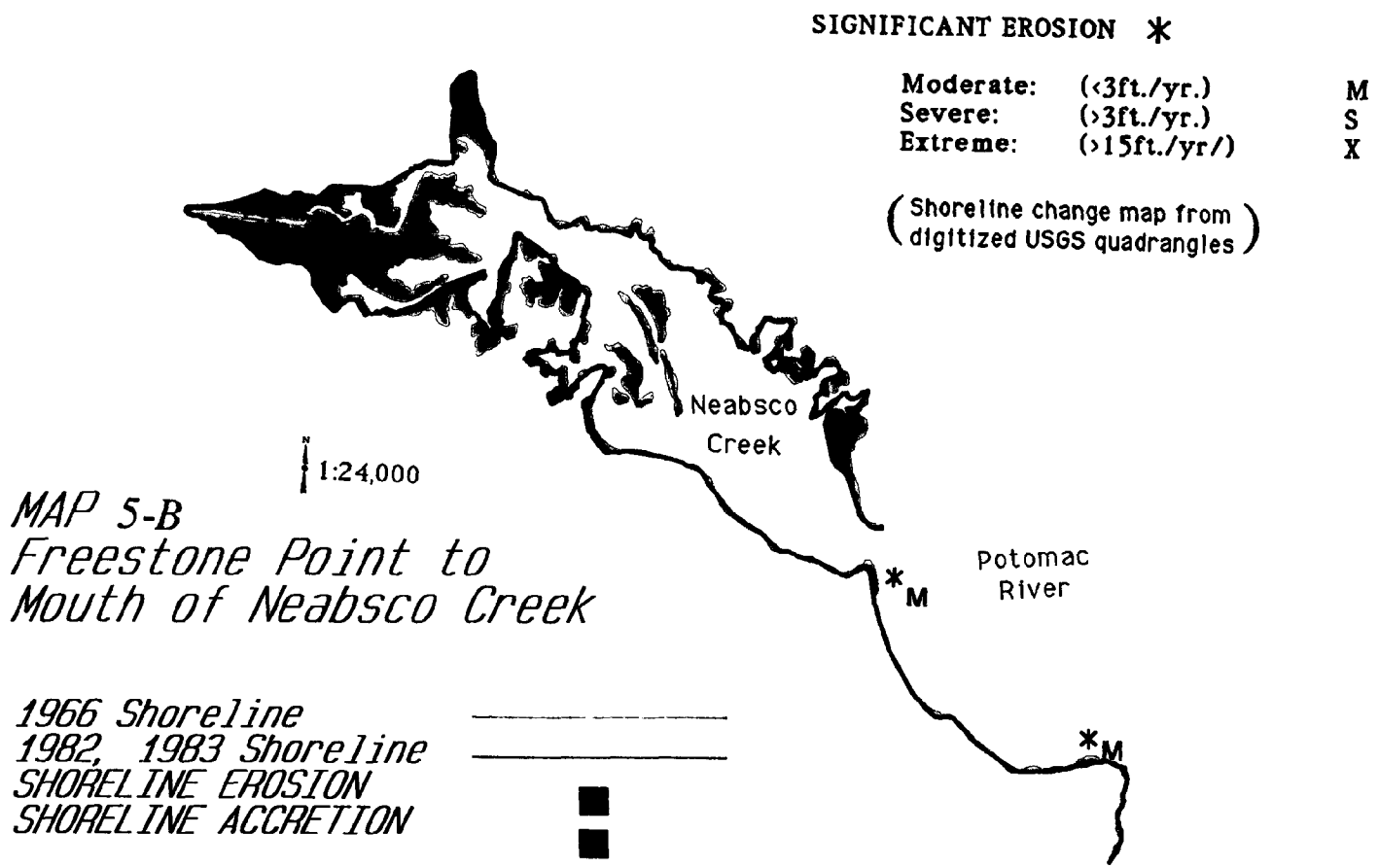
Artificial Stabilization:
Only 5% of the total shoreline is armored with .3 mile riprap (40%) and bulkhead (60%). There is some riprap on either side of the railroad bridge, and bulkhead in the marinas on the south side of Neabsco Creek. Rogers *et al.*, 1976, indicated that the bulkheading is mainly for cosmetic and commercial purposes.



Map 5-A **Freestone Point to Mouth of Neabsco Creek** 1:24,000

PW *(Quantico to Indian Head)*

-Reference map from USGS Topo Quadrangles-

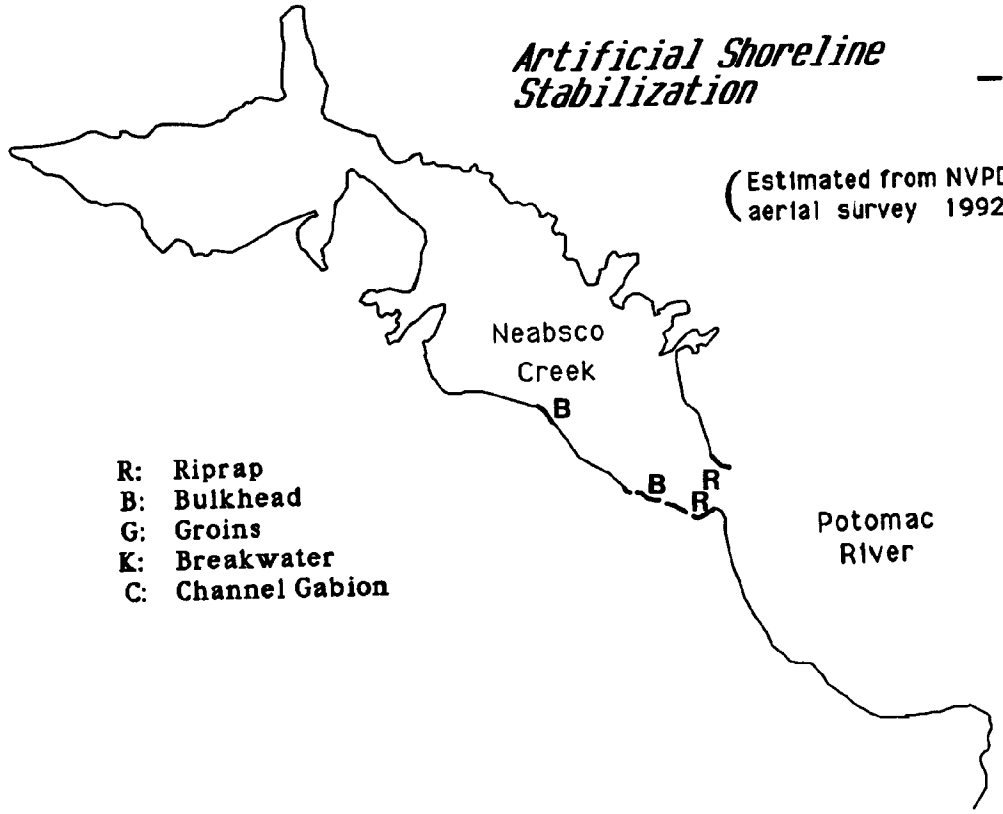

SIGNIFICANT EROSION *
Moderate: (<3ft./yr.) M
Severe: (>3ft./yr.) S
Extreme: (>15ft./yr/) X
(Shoreline change map from digitized USGS quadrangles)
Neabsco Creek
Potomac River
*M
*M
1:24,000
MAP 5-B
Freestone Point to
Mouth of Neabsco Creek
1966 Shoreline
1982, 1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

MAP 5-C
Freestone Point to Mouth of Neabsco Creek

1:24,000

Artificial Shoreline Stabilization ---------

(Estimated from NVPDC aerial survey 1992)



R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 6

Shoreline Segment: Mouth of Neabsco Creek to Deephole Point

USGS Quadrangles: Quantico
Indian Head
Fort Belvoir
Occoquan

County: Prince William

Property Maps: 14N, 20S, 19S, 19N, 20N, 29S, 28S, 28N

Water Body: Occoquan Bay
Farm Creek
Marumsco Creek
unnamed tributaries

Shoreline Description:

There are 11.6 miles of shoreline from the northern side of the mouth of Neabsco Creek to Deephole Point. Approximately 4.1 miles of this segment lies directly on the Potomac River, 3.4 miles are along Marumsco Creek, 3.2 miles of the shoreline is along Farm Creek, and the remaining 0.9 mile is along smaller unnamed tributaries.

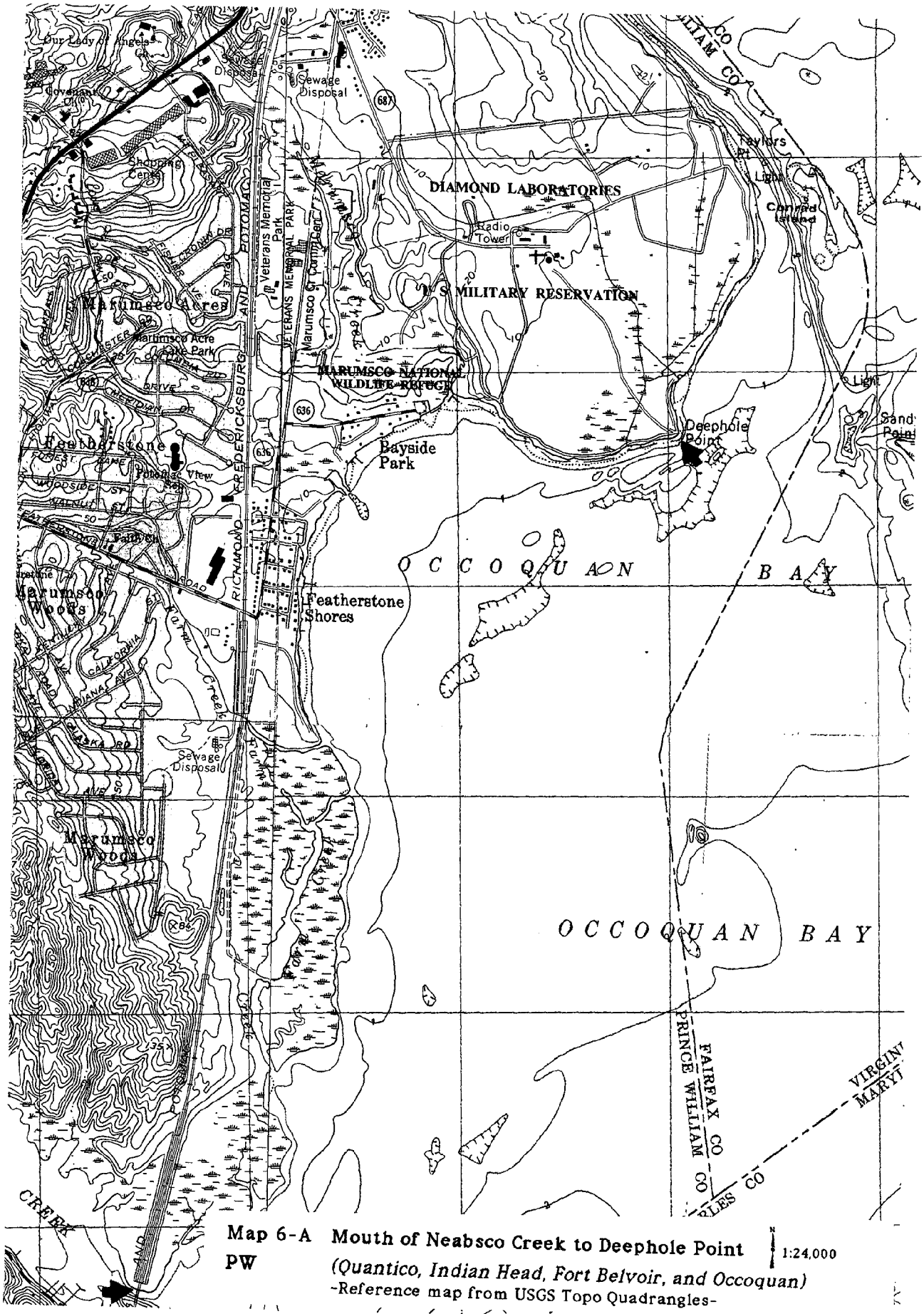
There are two residential areas, Featherstone Shores and Bayside Park located in this segment between Farm Creek and Marumsco Creek. Marumsco National Wildlife Refuge, Veterans Memorial Park, and the Marumsco Creek Community Center are located along Marumsco Creek. The shoreline to the north of Marumsco Creek is part of the Diamond Laboratories U.S. Military Reservation.

Erosion Situation:

The shoreline changes map shows that erosion and accretion have occurred along the Farm Creek and Marumsco Creek marsh shorelines; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes. The residential areas of Featherstone Shores and Bayside Park have experienced moderately (<3 ft/yr) eroding shorelines. The shoreline changes shown for the small area of open water between Featherstone Shores and Bayside Park indicate that this area was established between the late 60s and early 80s; therefore the "erosion" of this basin is not a continuous trend.

Artificial Stabilization:

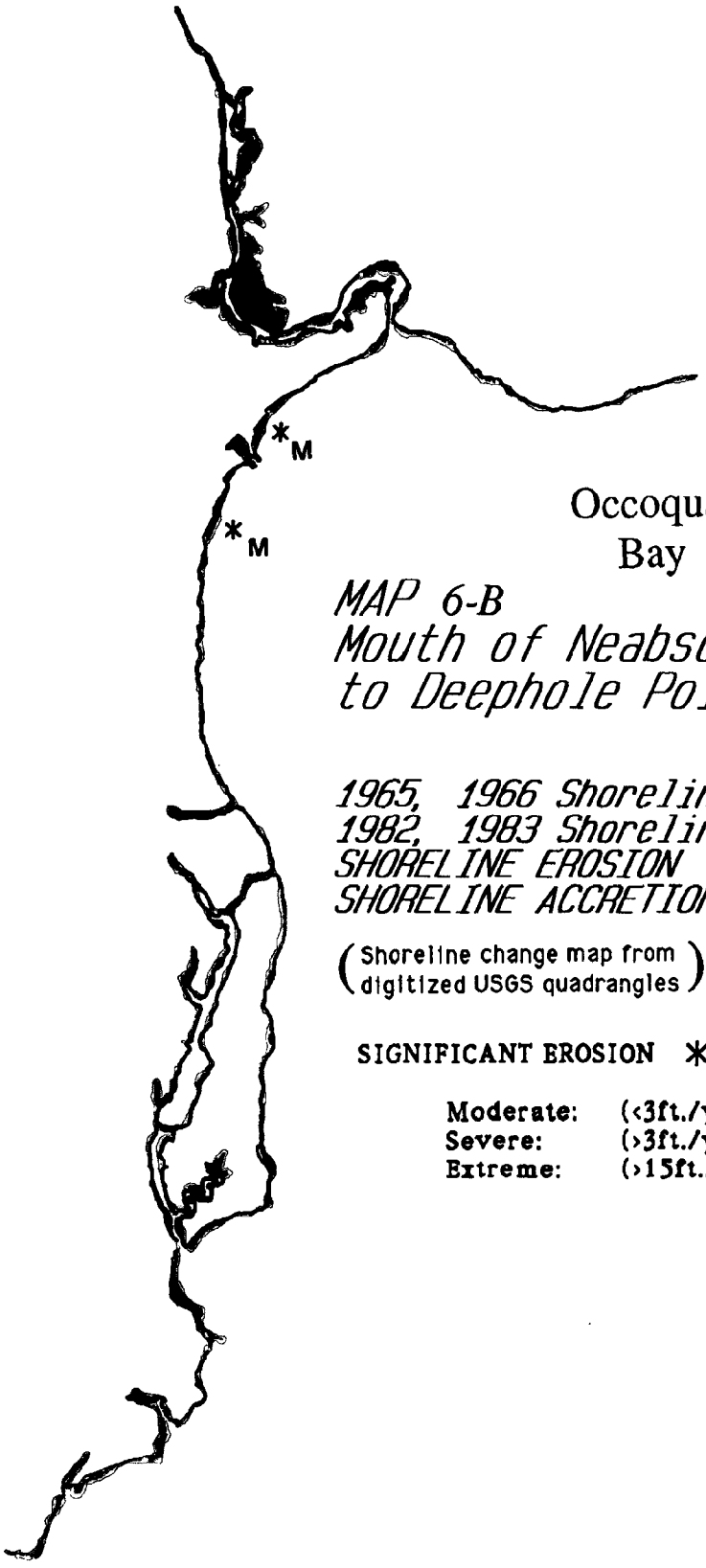
Only 15% of the shoreline in this segment has been artificially stabilized with 1.8 miles of riprap (50%), bulkhead (45%), and several groins (5%). Most of the riprap is just south of Deephole Point along the military reservation. There is also some riprap on either side of the basin between Featherstone Shores and Bayside Park with bulkheading inside the basin. Bulkhead extends along Featherstone Shores and Bayside Park with some gaps, and a small groin field. Rogers *et al.*, 1976, indicated that the bulkheading at the marina is mainly used for commercial purposes.



Map 6-A **Mouth of Neabsco Creek to Deephole Point** 1:24,000

PW *(Quantico, Indian Head, Fort Belvoir, and Occoquan)*

-Reference map from USGS Topo Quadrangles-



Occoquan
Bay

MAP 6-B
Mouth of Neabsco Creek to Deephole Point

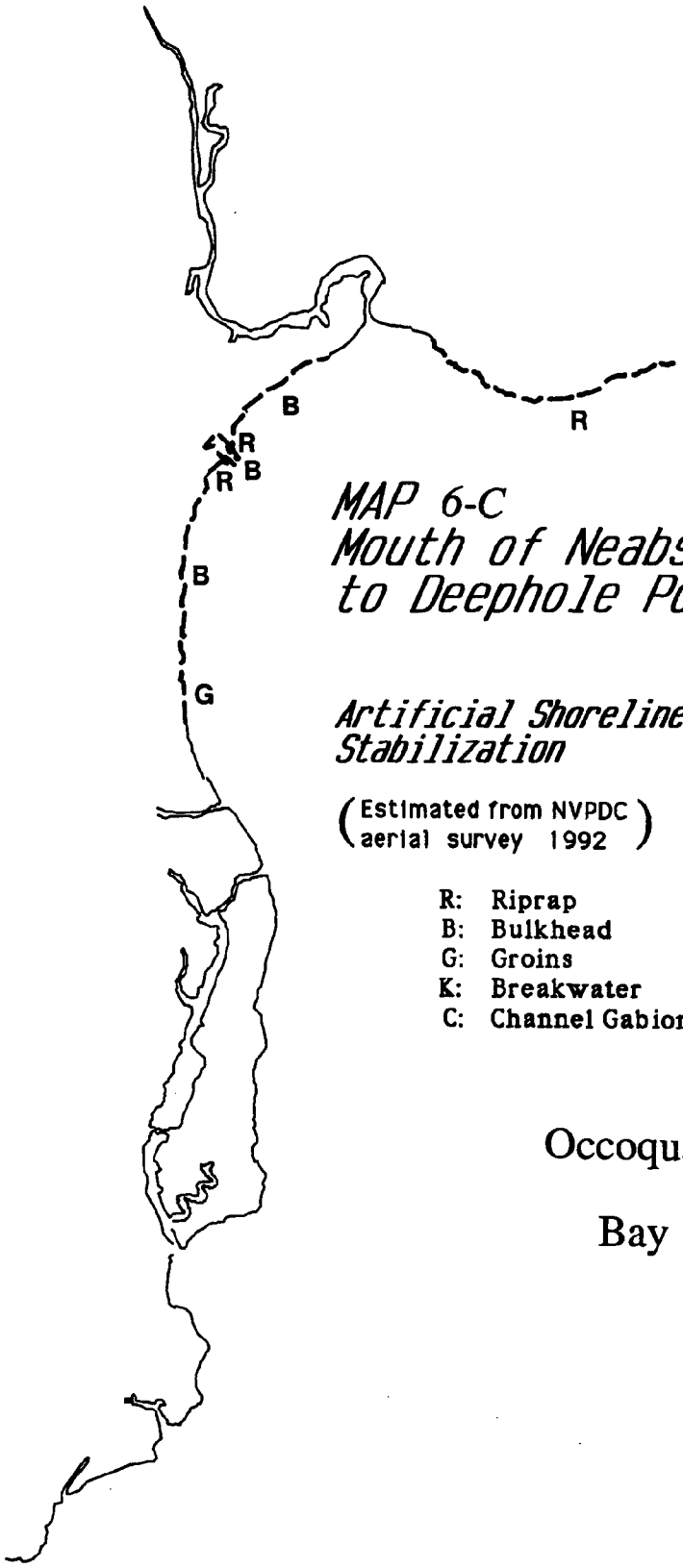
1:24,00

1965, 1966 Shoreline
1982, 1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



MAP 6-C
Mouth of Neabsco Creek to Deephole Point

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

Occoquan

Bay

MAP 7

Shoreline Segment: Deephole Point to Occoquan River Dam

USGS Quadrangles: Fort Belvoir
Occoquan

County: Prince William

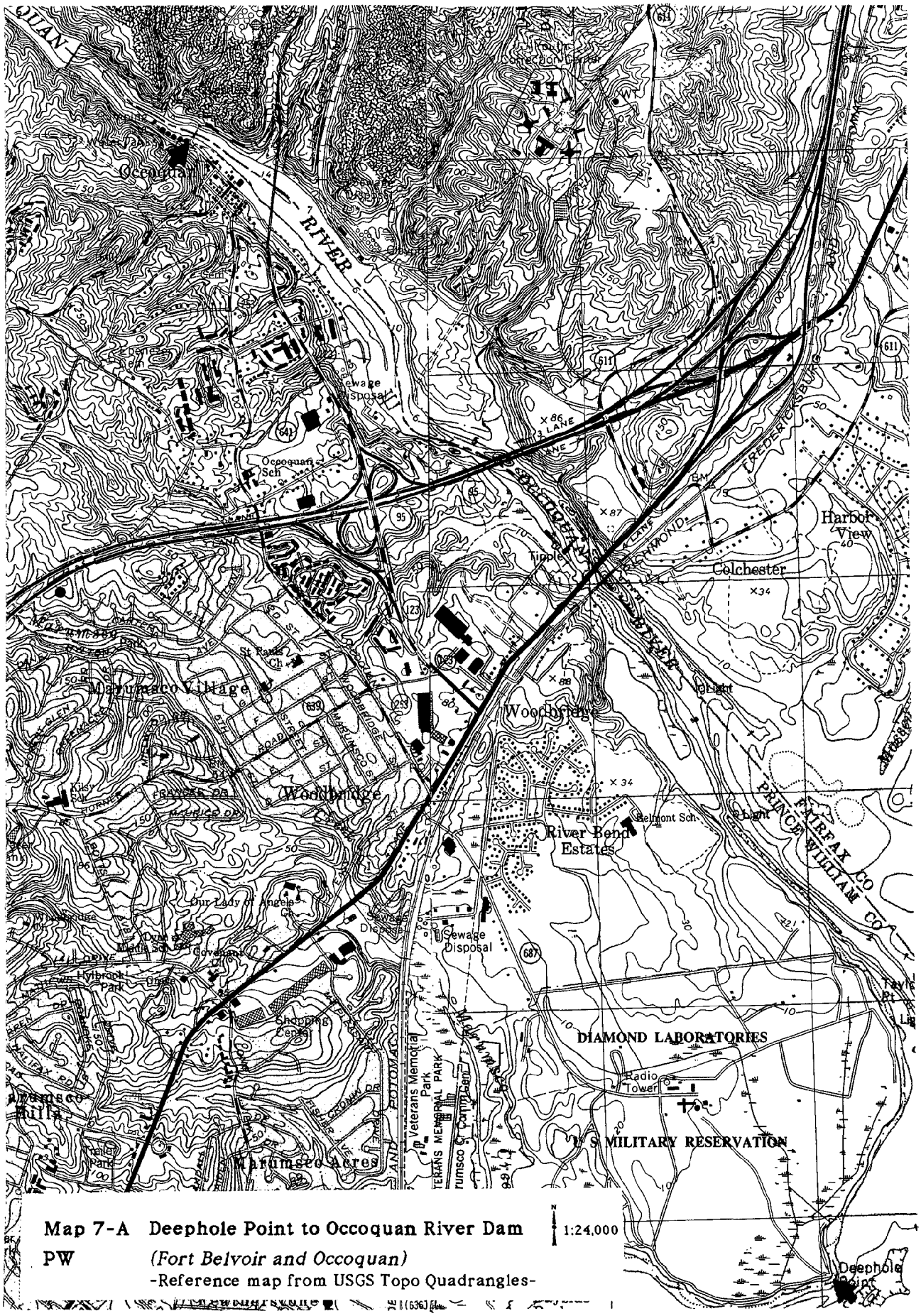
Property Maps: 28N, 42S, 42N, 56S, 57S, 57N

Water Bodies: Belmont Bay
Occoquan River

Shoreline Description:
There are 6.0 miles of shoreline from Deephole Point to the Occoquan River Dam. Approximately 1.6 miles of shoreline are along Belmont Bay; the remaining 4.4 miles are along the Occoquan River. The shoreline around Deephole Point is part of the Diamond Laboratories U.S. Military Reservation site. There is a good deal of development along the Occoquan River. Both Woodbridge and the Town of Occoquan have residential areas along the shoreline. There are also several commercial and industrial areas. There are numerous piers and several marinas along this segment. There is a sewage disposal station to the south of Occoquan, and several large water tanks and a pumping station to the north of Occoquan. There are several bridges across the Occoquan River for the Richmond, Fredricksburg, and Potomac Railroad, Route 1, Interstate 95, and Route 123.

Erosion Situation:
The shoreline changes map shows that some of the shoreline along the Occoquan River has experienced moderate (<3 ft/yr) to severe (>3 ft/yr) erosion. The shorelines of some of the low lying areas have changed due to shifting marsh and beach shoreline.

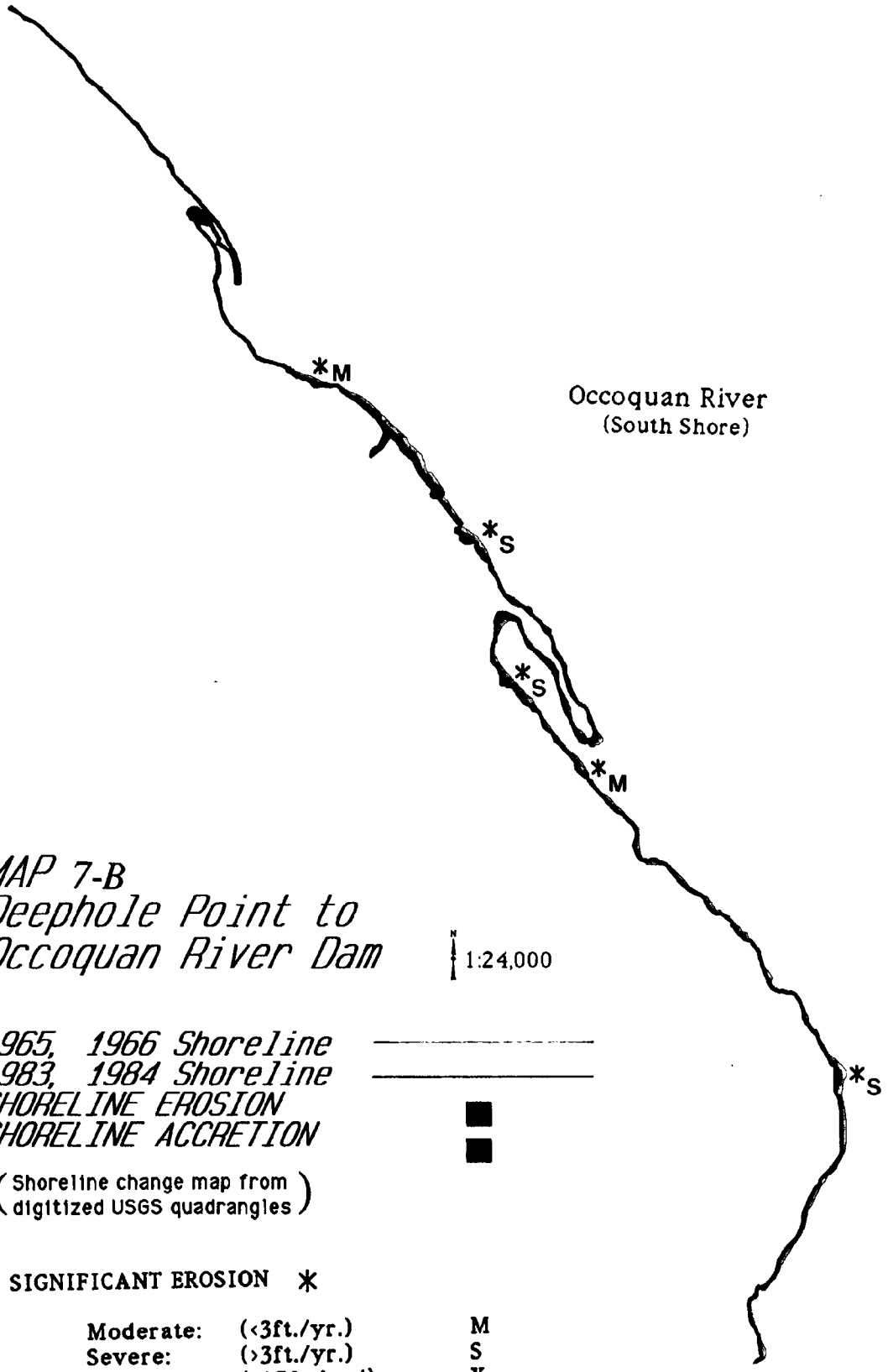
Artificial Stabilization:
Approximately 40% of the total shoreline is hardened with 2.4 miles of bulkhead (60%) and riprap (40%). There are also two attached marsh islands along the Occoquan River that are old overgrown breakwaters. There is bulkheading along the commercial and industrial areas, and along most of Occoquan. The riprap is mainly along the military reservation.



Map 7-A **Deephole Point to Occoquan River Dam** 1:24,000

PW *(Fort Belvoir and Occoquan)*

-Reference map from USGS Topo Quadrangles-



Occoquan River
(South Shore)

MAP 7-B
Deephole Point to Occoquan River Dam

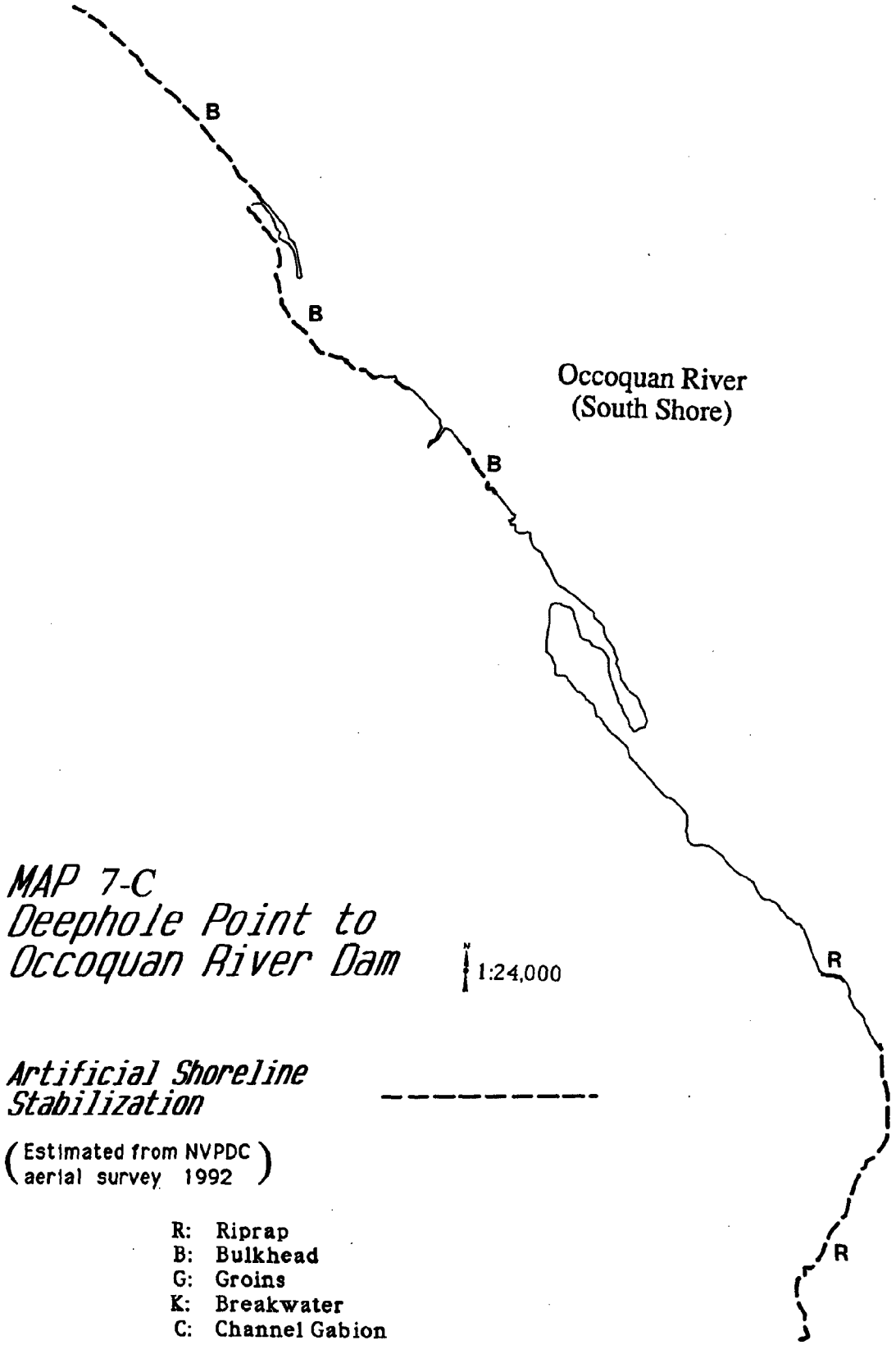
N
1:24,000

1965, 1966 Shoreline
1983, 1984 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	(<3ft./yr.)	M
Severe:	(>3ft./yr.)	S
Extreme:	(>15ft./yr/)	X



MAP 7-C
Deephole Point to Occoquan River Dam

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 8

Shoreline Segment: Occoquan River Dam to Route 1 Bridge

USGS Quadrangles: Fort Belvoir
Occoquan

County: Fairfax

Property Maps: 112-2, 112-4, 113-3

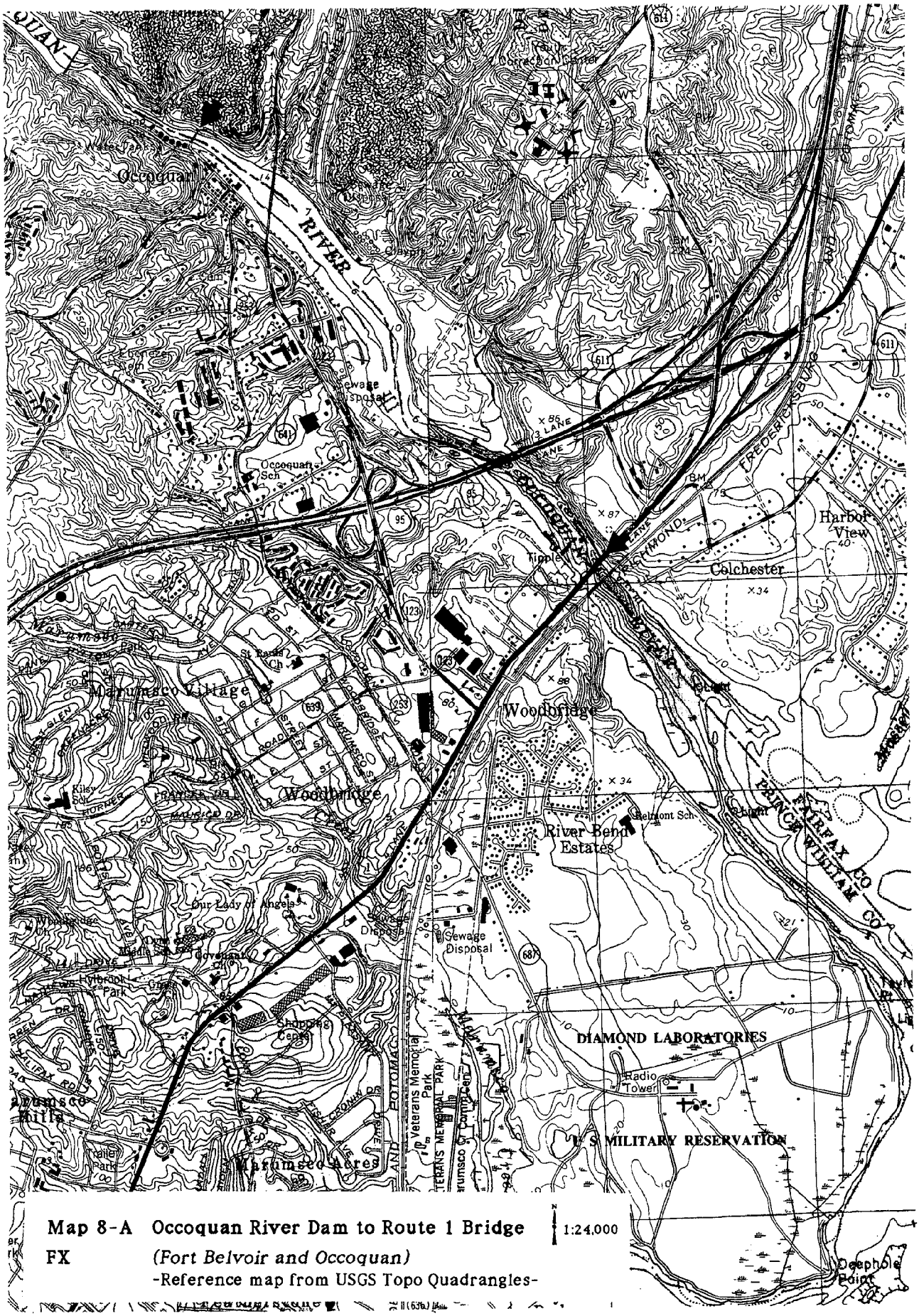
Water Body: Occoquan River

Shoreline Description:
There are 2.1 miles of shoreline from the Occoquan River Dam to the Route 1 Bridge. This segment is entirely on the Occoquan River.

The District of Columbia Department of Corrections (Lorton Reformatory) occupies part of this segment. There is a large quarry close to the shore and a sewage disposal area. There are several bridges across the Occoquan River for Route 123, Interstate 95, Route 1, and the Richmond, Fredricksburg, and Potomac Railroad. The shoreline runs along the Occoquan Regional Park between Route 123 to near Interstate 95.

Erosion Situation:
The shoreline changes map shows that there was a change in the open water area at the mouth of an unnamed creek to the north of the Interstate 95 bridge; this change happened in the late 60s or 70s and does not necessarily represent a significant trend. There map also shows moderate (< 3 ft/yr) bluff erosion to the south of the Interstate 95 bridge.

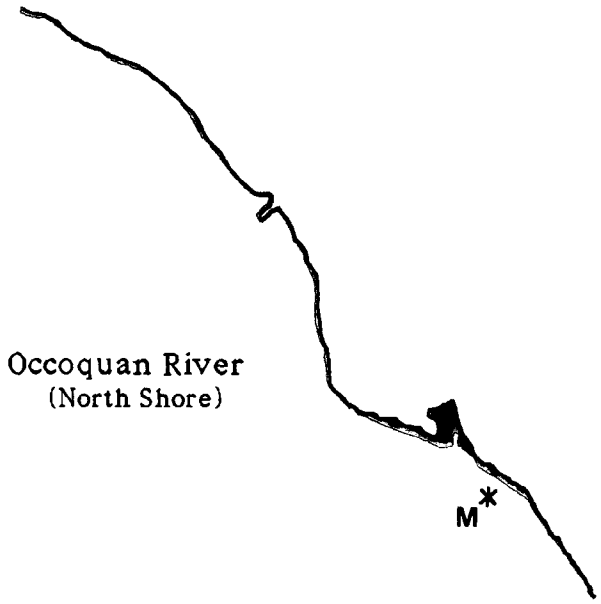
Artificial Stabilization:
Only 8% of the shoreline is stabilized with .2 mile of artificial structures, 60% of which is bulkhead and 40% riprap. Owen *et al.*, 1979, indicated that the structures were mainly erected for cosmetic and commercial purposes.



Map 8-A **Occoquan River Dam to Route 1 Bridge** 1:24,000

FX *(Fort Belvoir and Occoquan)*

-Reference map from USGS Topo Quadrangles-



MAP 8-B
Occoquan River Dam to Route 1 Bridge

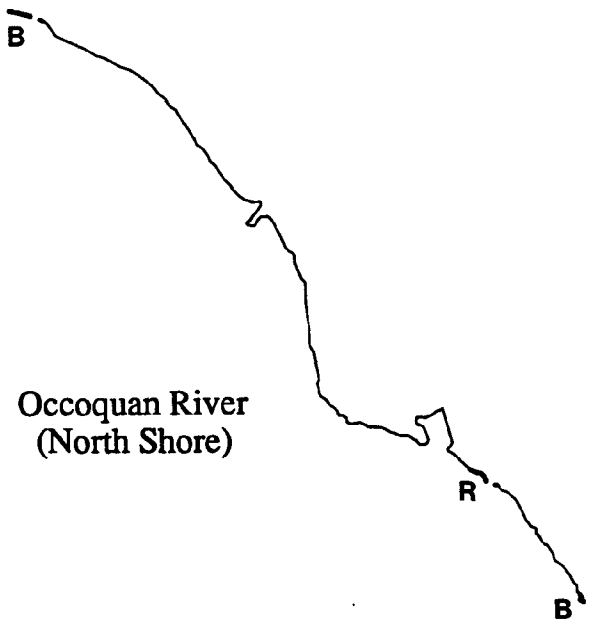
1:24,000

1965, 1966 Shoreline
1983, 1984 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



MAP 8-C
Occoquan River Dam to Route 1 Bridge

1:24,000

Artificial Shoreline Stabilization ---------

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 9

Shoreline Segment: Route 1 Bridge to Kanes Creek

USGS Quadrangle: Fort Belvoir

County: Fairfax

Property Maps: 113-3, 117-1, 117-2, 113-4, 118-1, 118-3

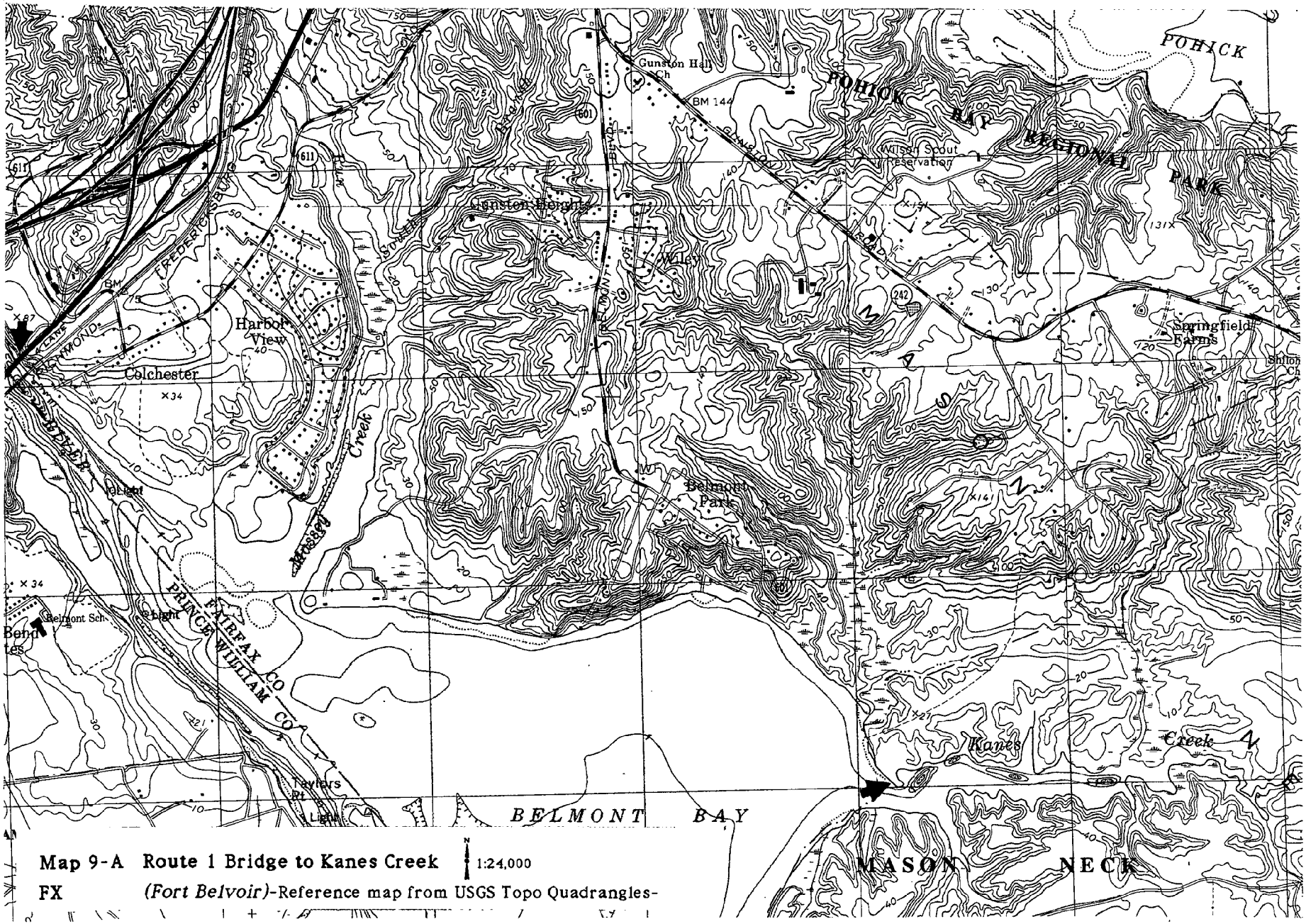
Water Bodies: Occoquan River
Massey Creek
Belmont Bay
unnamed tributary

Shoreline Description:
There are 6.8 miles of shoreline from Route 1 Bridge to Kanes Creek. Approximately 1.2 miles of the shoreline are along the Occoquan River, 2.6 miles are along Massey Creek, 2.1 miles are along Belmont Bay, and the remaining 0.9 mile of shoreline is along a marshy tributary to the northwest of Kanes Creek.

There are several piers and boat ramps in this segment. To the southeast of the Route 1 Bridge, is the Colchester residential area and the Fairfax Yacht Club. The shoreline on the west side of Massey Creek is now almost entirely developed. There are a few houses at the southeast mouth of Massey Creek, around Frenchmans Point. There are several more houses between Frenchmans Point and the tributary just northwest of Kanes Creek. The boundary for Mason Neck State Park lies between the tributary and Kanes Creek.

Erosion Situation:
The shoreline changes map shows that there have been shifting marsh shorelines along Massey Creek, in the marsh area just to the north of the creek, and along the unnamed tributary at the mouth of Kanes Creek; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes. There has also been some moderate (< 3 ft/yr) erosion along several bluffs on Belmont Bay.

Artificial Stabilization:
Only 25% of the shoreline in this segment has been artificially stabilized with 1.7 miles of bulkhead (65%), riprap (30%), and groins (5%). The structures are spread throughout the segment. Most of the residences along Massey Creek are armored with only a few gaps.



Map 9-A Route 1 Bridge to Kanes Creek 1:24,000

FX *(Fort Belvoir)*-Reference map from USGS Topo Quadrangles-

MAP 9-B
Route 1 Bridge to Kanes Creek

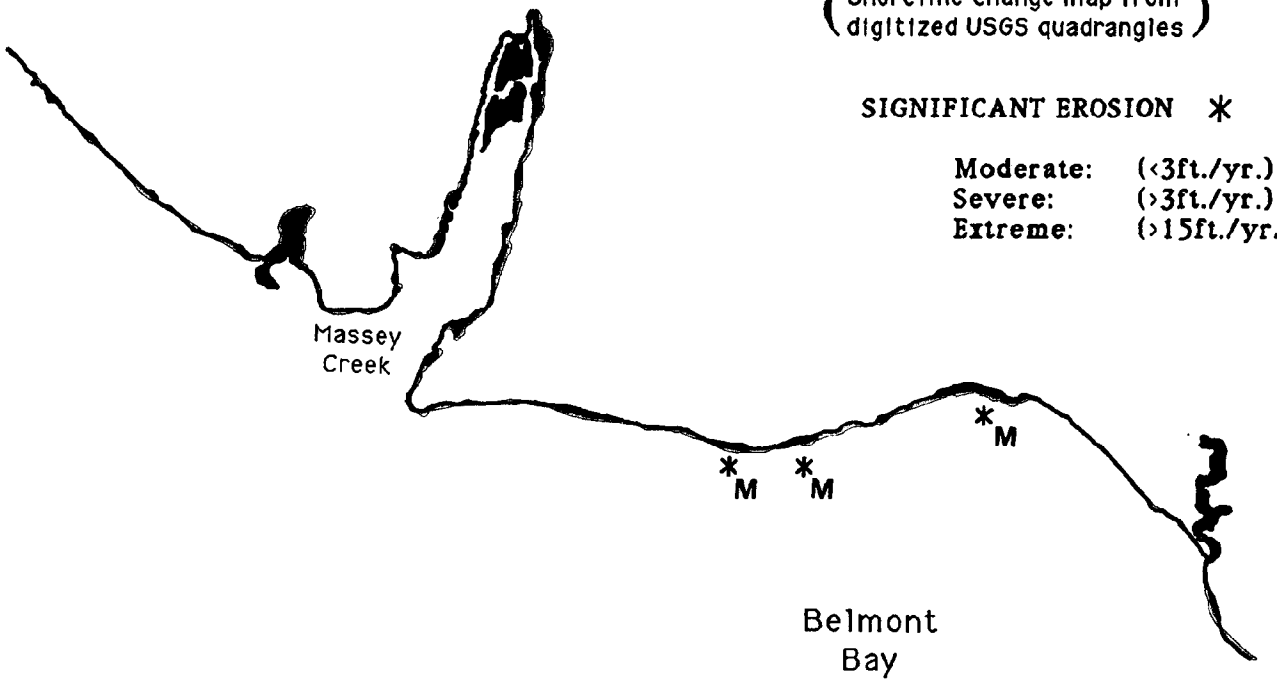
1:24,000

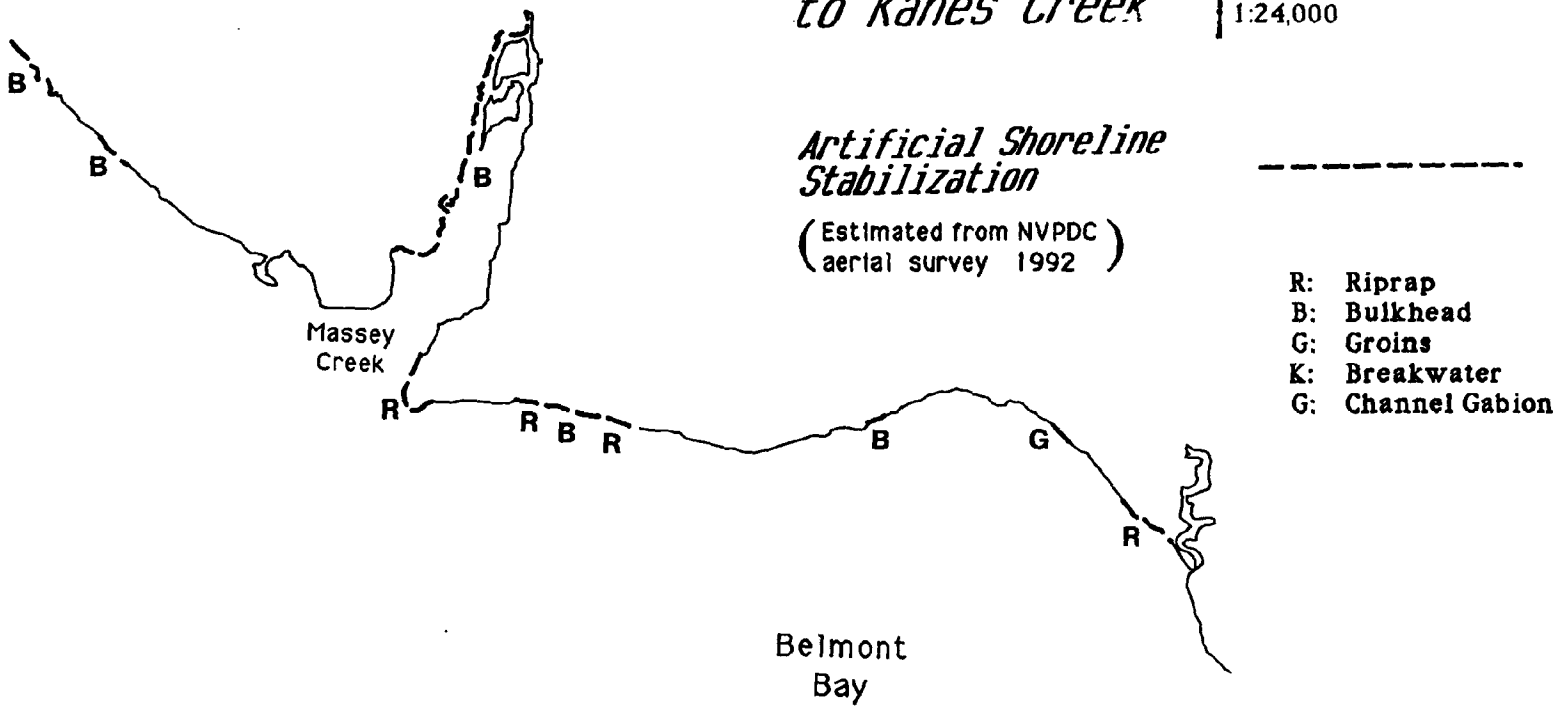
1965 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**




MAP 9-C
Route 1 Bridge
to Kanes Creek
1:24,000
Artificial Shoreline
Stabilization
(Estimated from NVPDC
aerial survey 1992)
R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
G: Channel Gabion
B
B
B
Massey
Creek
R
R B R
B
G
R
Belmont
Bay

MAP 10

Shoreline Segment: Kanes Creek to Sandy Point

USGS Quadrangle: Fort Belvoir

County: Fairfax

Property Maps: 118-3, 118-4, 121-1, 120-2

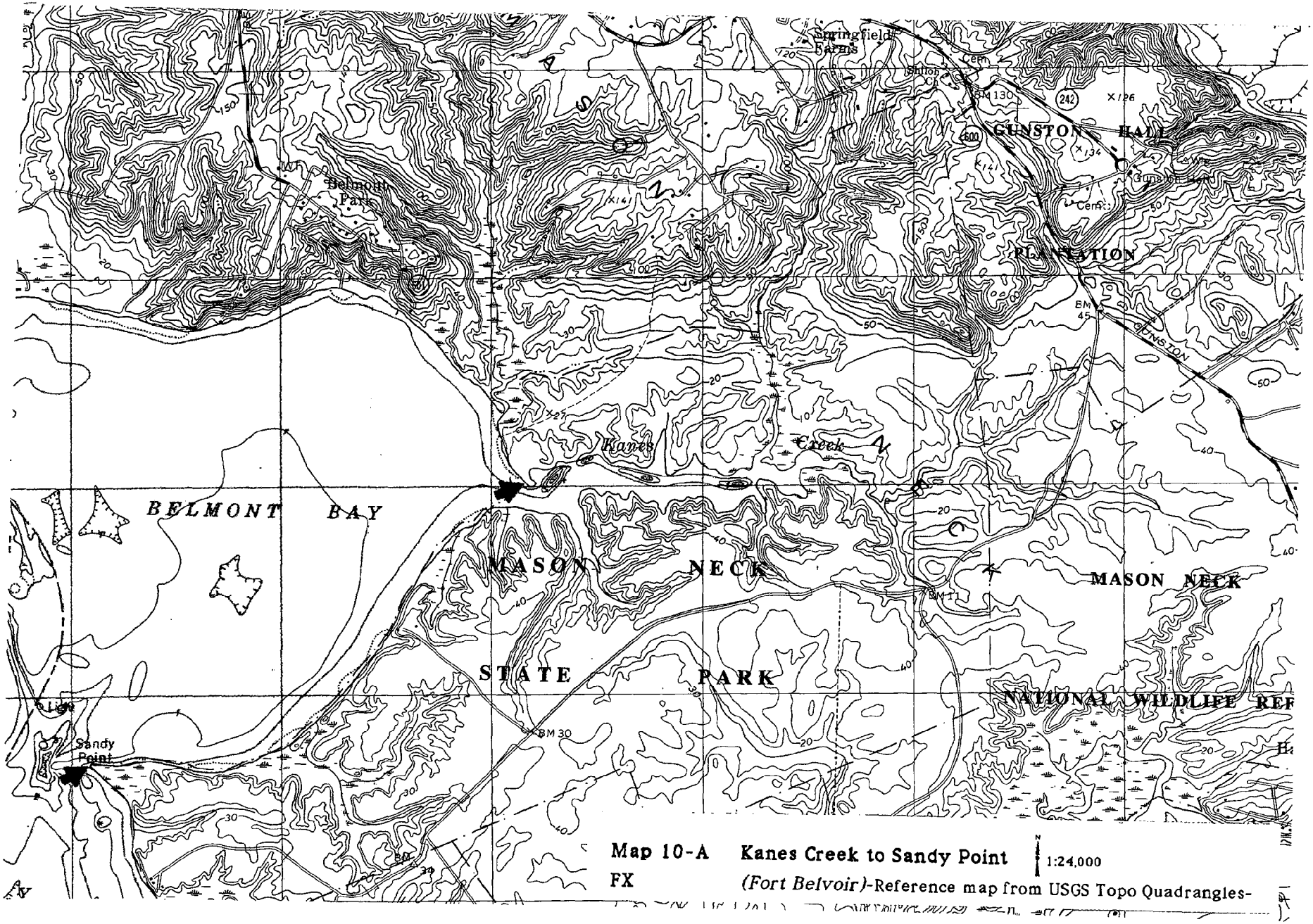
Water Bodies: Kanes Creek
Belmont Bay

Shoreline Description:
There are 6.6 miles of shoreline from Kanes Creek to Sandy Point. Approximately 5 miles are along the convoluted shoreline of Kanes Creek, and the remaining 1.7 miles are along the relatively smooth shoreline of Belmont Bay.

The entire shoreline borders Mason Neck State Park. The park's Visitors Center is along the Belmont Bay shoreline.

Erosion Situation:
The shoreline changes map shows that the Kanes Creek shoreline has changed significantly. Some marsh areas along the Belmont Bay shoreline have also changed; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes.

Artificial Stabilization:
None of the shoreline in this segment has been artificially stabilized.



Map 10-A **Kanes Creek to Sandy Point** 1:24,000

FX *(Fort Belvoir)*-Reference map from USGS Topo Quadrangles-

MAP 10-B
Kanes Creek to Sandy Point

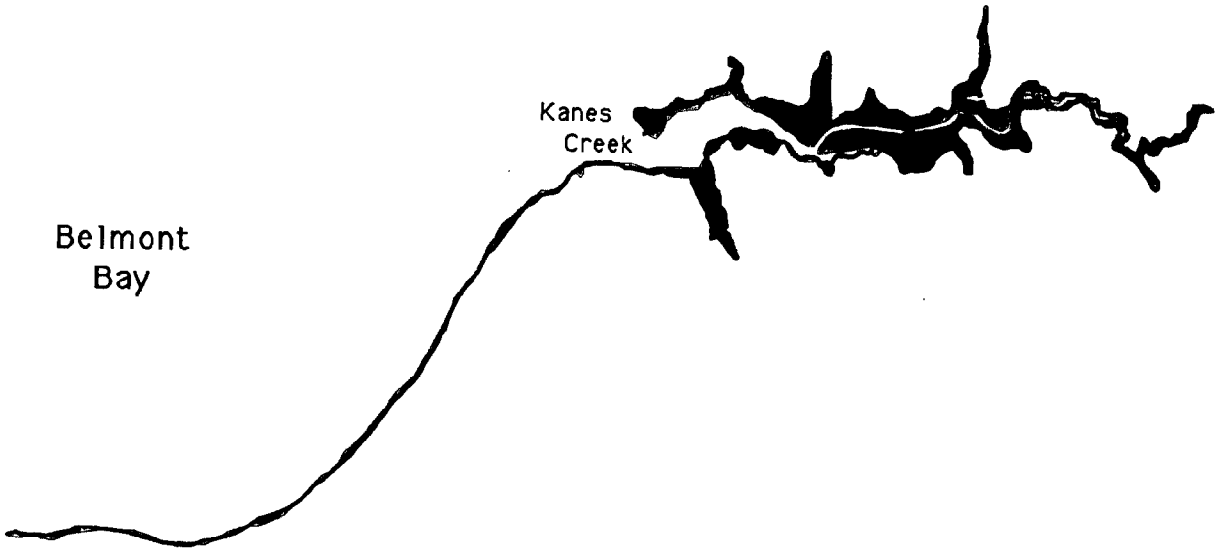
1:24,000

1965 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**

(Shoreline change map from digitized USGS quadrangles)



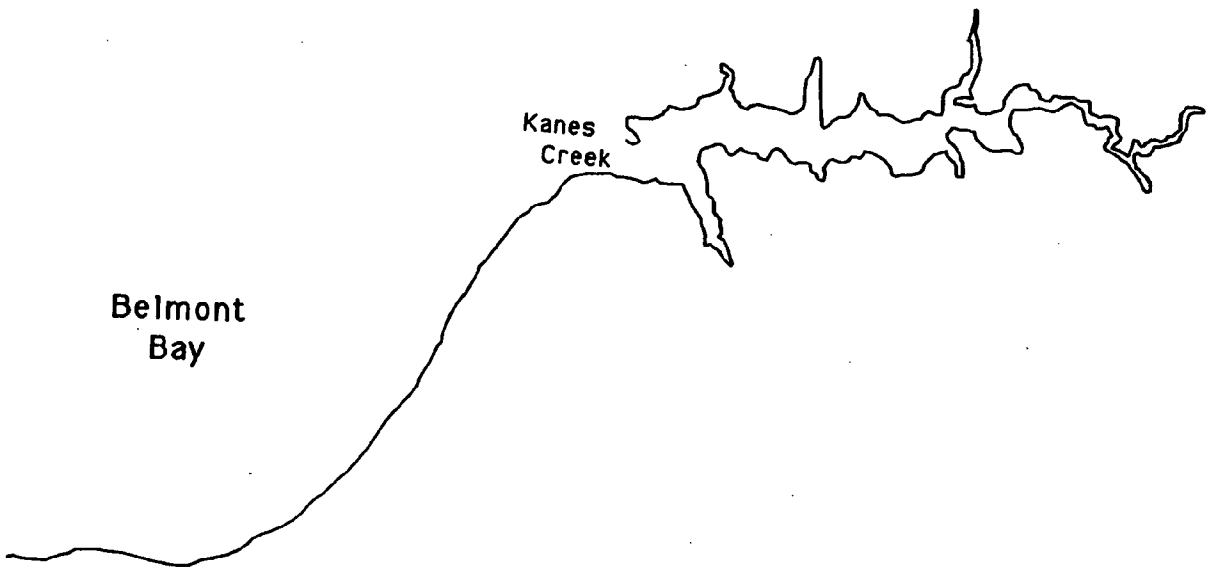
MAP 10-C
Kanes Creek to Sandy Point

Artificial Shoreline Stabilization

1:24,000

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

(Estimated from NVPDC aerial survey 1992)



MAP 11

Shoreline Segment: Sandy Point to Sycamore Point

USGS Quadrangles: Indian Head
Fort Belvoir

County: Fairfax

Property Maps: 120-2, 121-1, 121-3

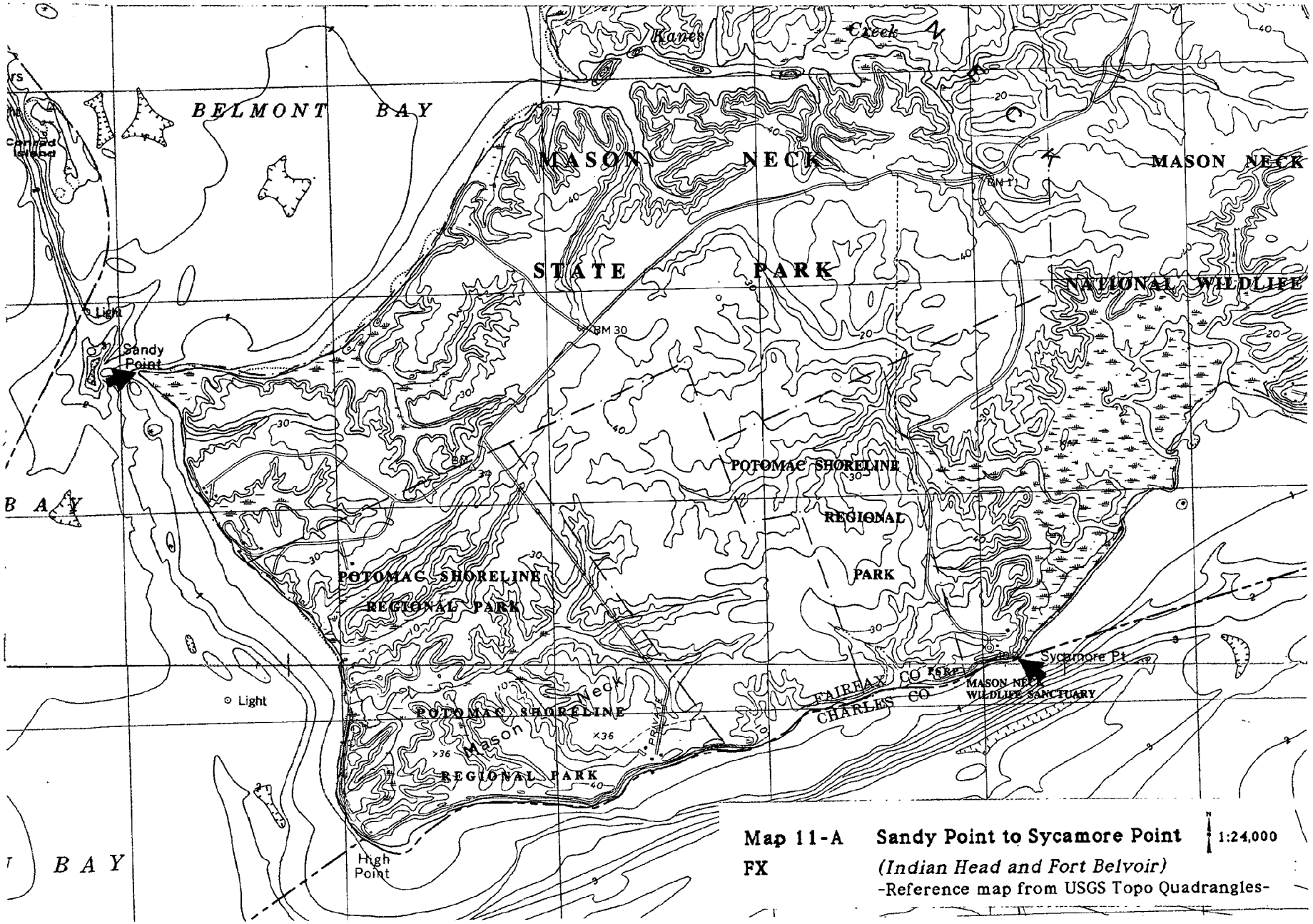
Water Bodies: Occoquan Bay
Potomac River

Shoreline Description:
There are 3.7 miles of shoreline from Sandy Point to Sycamore Point. Approximately 1.7 miles of shoreline from Sandy Point to High Point are on the Occoquan Bay, and the remaining 2.0 miles are on the Potomac River.

This segment contains shoreline along Mason Neck State Park, Potomac Shoreline Regional Park, and Mason Neck Wildlife Sanctuary. There are also a few houses along the shore.

Erosion Situation:
The shoreline changes map shows that moderate (< 3 ft/yr) erosion has occurred on the Belmont Bay shoreline and severe (> 3 ft/yr) erosion has occurred around High Point. Owen *et al.*, 1979, indicated that most of the shoreline in this segment has experienced moderate bluff erosion (1 to 3 ft/yr). Miller, 1987, did a detailed field study of High Point from February 1980 to July 1981; his results indicated that there was a mean recession rate of 1.3 to 1.6 ft/yr. He also did cartographic and photogrammetric analyses that gave rates of 0.7 ft/yr and 2.0 ft/yr for this part of Mason Neck.

Artificial Stabilization:
Only 16% of the shoreline in this segment has been artificially stabilized with .6 mile of riprap (80%) and bulkheads (20%). The area to the south of Sandy Point has two sections of riprap and a small section of bulkhead. Some more riprap was used along the levee in Potomac Shoreline Regional Park. Another small section of bulkhead is along the shoreline of a private residence to the East of High Point.



Map 11-A **Sandy Point to Sycamore Point** 1:24,000

FX *(Indian Head and Fort Belvoir)*

-Reference map from USGS Topo Quadrangles-

MAP 11-B
Sandy Point to Sycamore Point

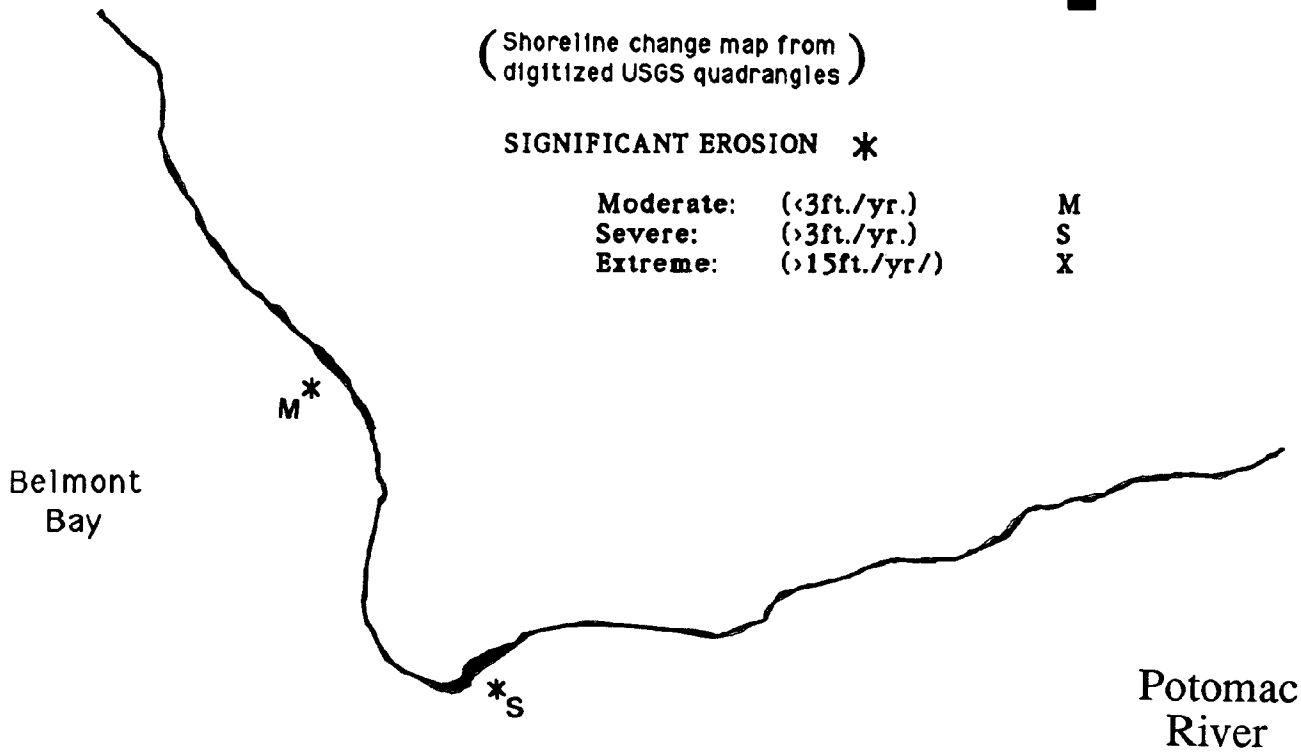
1:24,000

1965, 1966 Shoreline
1982, 1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



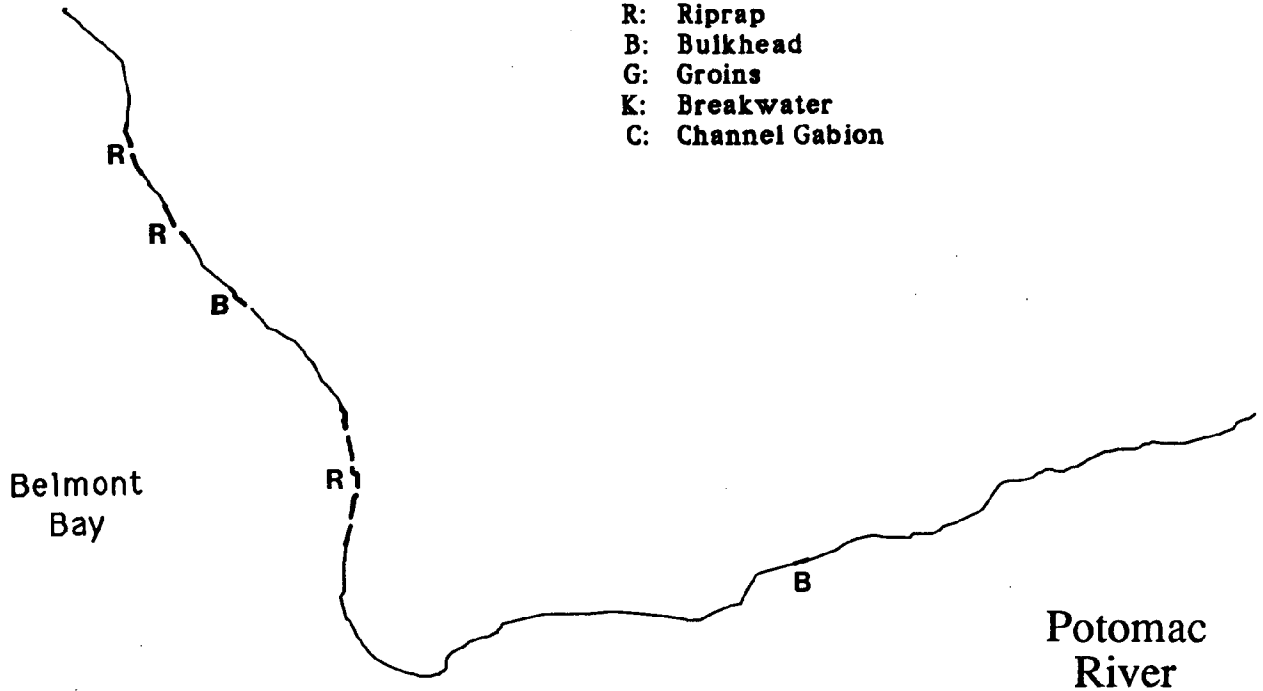
MAP 11-C
Sandy Point to Sycamore Point

1:24,000

Artificial Shoreline Stabilization ---------

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion



MAP 12

Shoreline Segment: Sycamore Point to Hallowing Point

USGS Quadrangle: Fort Belvoir

County: Fairfax

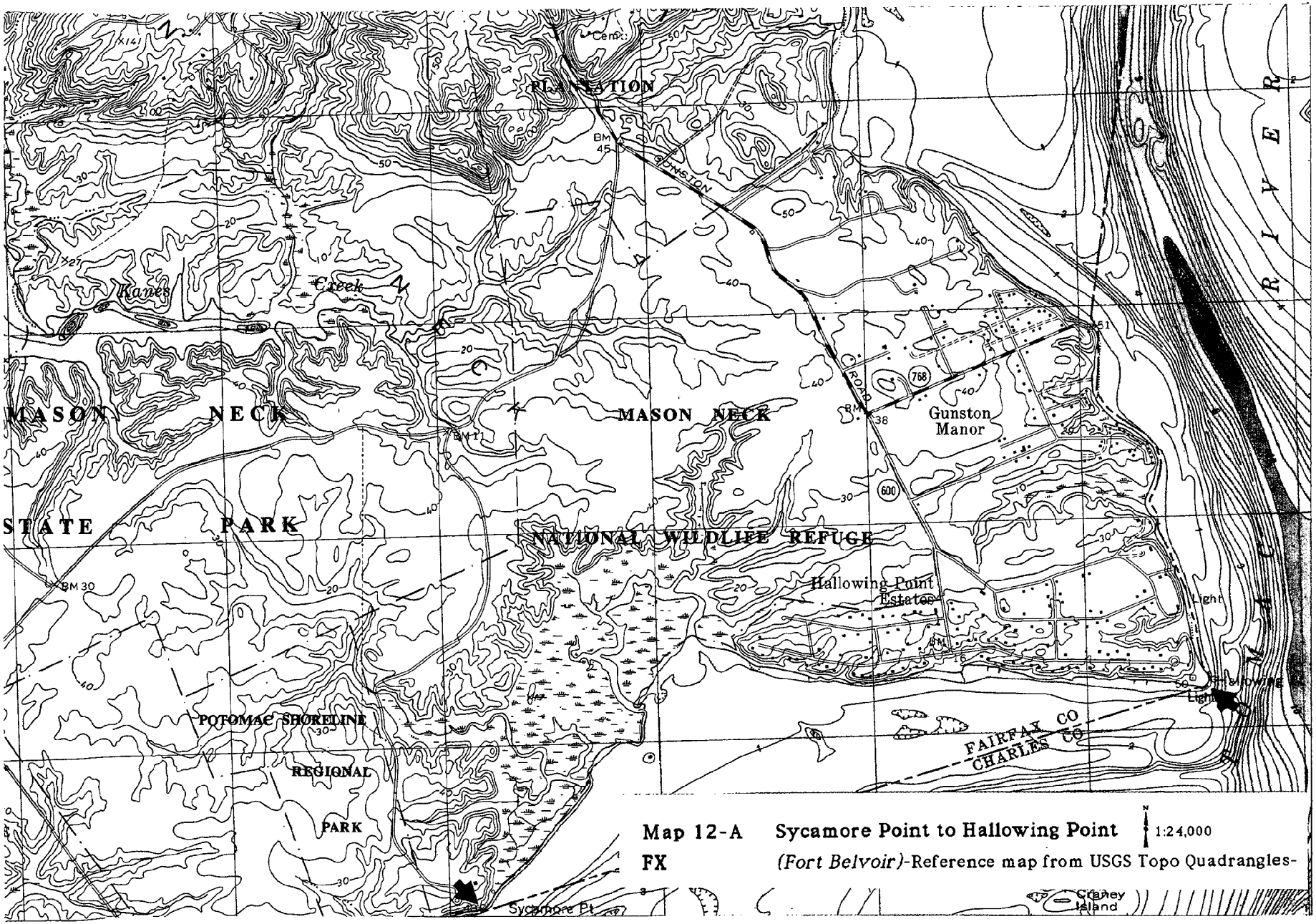
Property Maps: 121-3, 121-4, 122-1, 122-2

Water Body: Potomac River
unnamed tributaries

Shoreline Description:
There are 8.0 miles of shoreline from Sycamore Point to Hallowing Point. Approximately 2.8 miles of the shoreline lies directly on the Potomac River, and the remaining 5.2 miles are along tributaries in the marsh. The 1.4 miles of shoreline from the eastern edge of the marsh to Hallowing Point are heavily developed as part of Hallowing Point Estates; many of these homes have docks. The shoreline from Sycamore Point to the residential area is part of Mason Neck National Wildlife Refuge.

Erosion Situation:
The shoreline changes map shows that there have been significant changes in the marsh area to the northeast of Sycamore Point; however, the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes.

Artificial Stabilization:
Only 15% of the shoreline in this segment has been artificially stabilized with 1.2 mile of bulkheads (65%), riprap (30%), and a few groins (5%). All of these structures are along the shoreline of Hallowing Point Estates and were generally constructed on a property to property basis with some gaps in front of individual residences. Owens *et al.*, 1979, indicate that the gaps between the structures reduce their overall effectiveness.



Map 12-A Sycamore Point to Hallowing Point 1:24,000

FX *(Fort Belvoir)*-Reference map from USGS Topo Quadrangles-

MAP 12-B
Sycamore Point to Hallowing Point

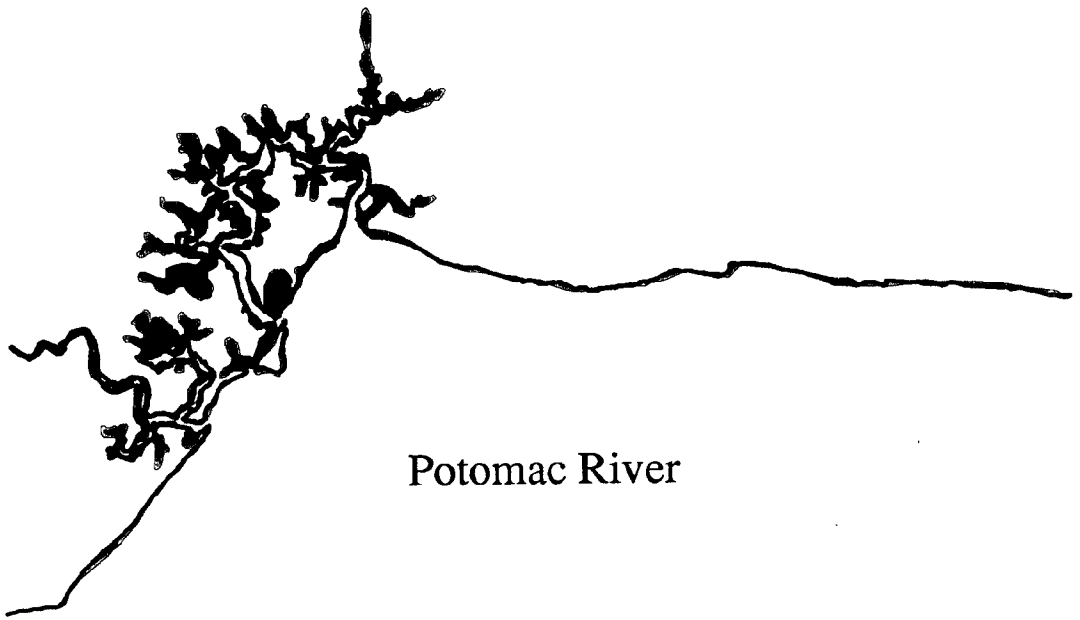
1:24,000

1965 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**

(Shoreline change map from digitized USGS quadrangles)



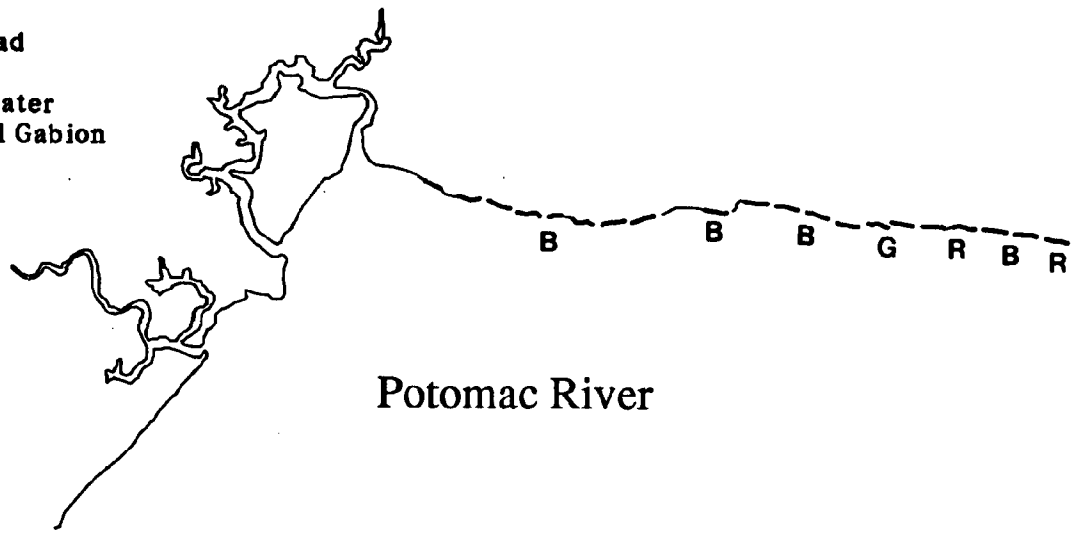
MAP 12-C
Sycamore Point to Hallowing Point

1:24,000

Artificial Shoreline Stabilization ---------

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion



MAP 13

Shoreline Segment: Hallowing Point to Pohick Bay

USGS Quadrangle: Fort Belvoir

County: Fairfax

Property Maps: 122-2, 119-4, 119-1, 115-3, 114-4

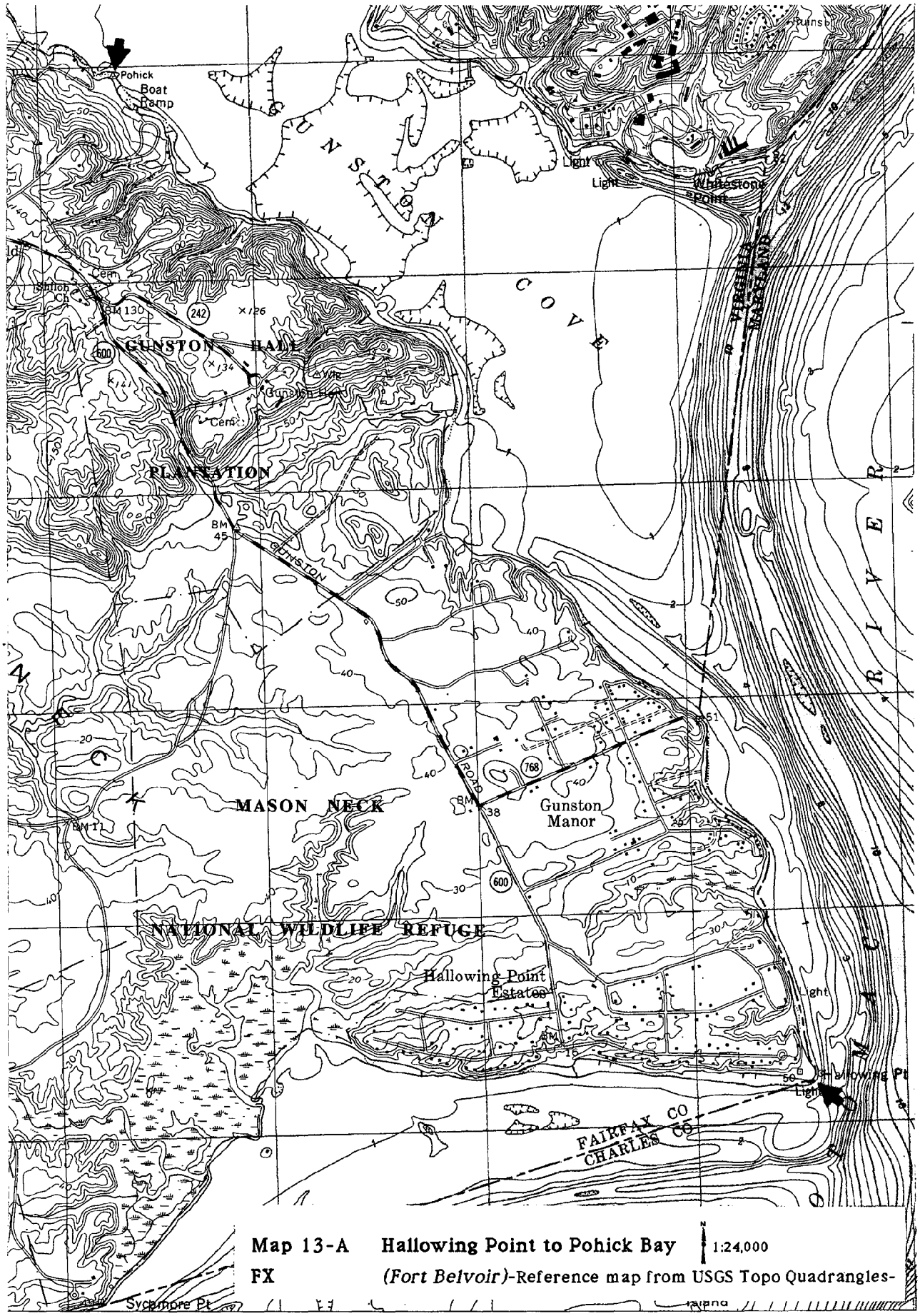
Water Bodies: Potomac River
Gunston Cove
unnamed tributary

Shoreline Description:
There are 4.7 miles of shoreline from Hallowing Point to Pohick Bay. Approximately 2.1 miles of this is on the Potomac River, and 2.1 miles are along Gunston Cove. The remaining 0.5 mile of shoreline is along a small tributary.

There are two residential areas to the north of Hallowing Point, Hallowing Point Estates, and Gunston Manor. The shoreline of this segment continues along past Gunston Hall Plantation, to approximately the mouth of Pohick Bay at the head of Gunston Cove. The northern portion of this segment is part of the Pohick Bay Regional Park where there is a large boat ramp. There are also several docks in this segment.

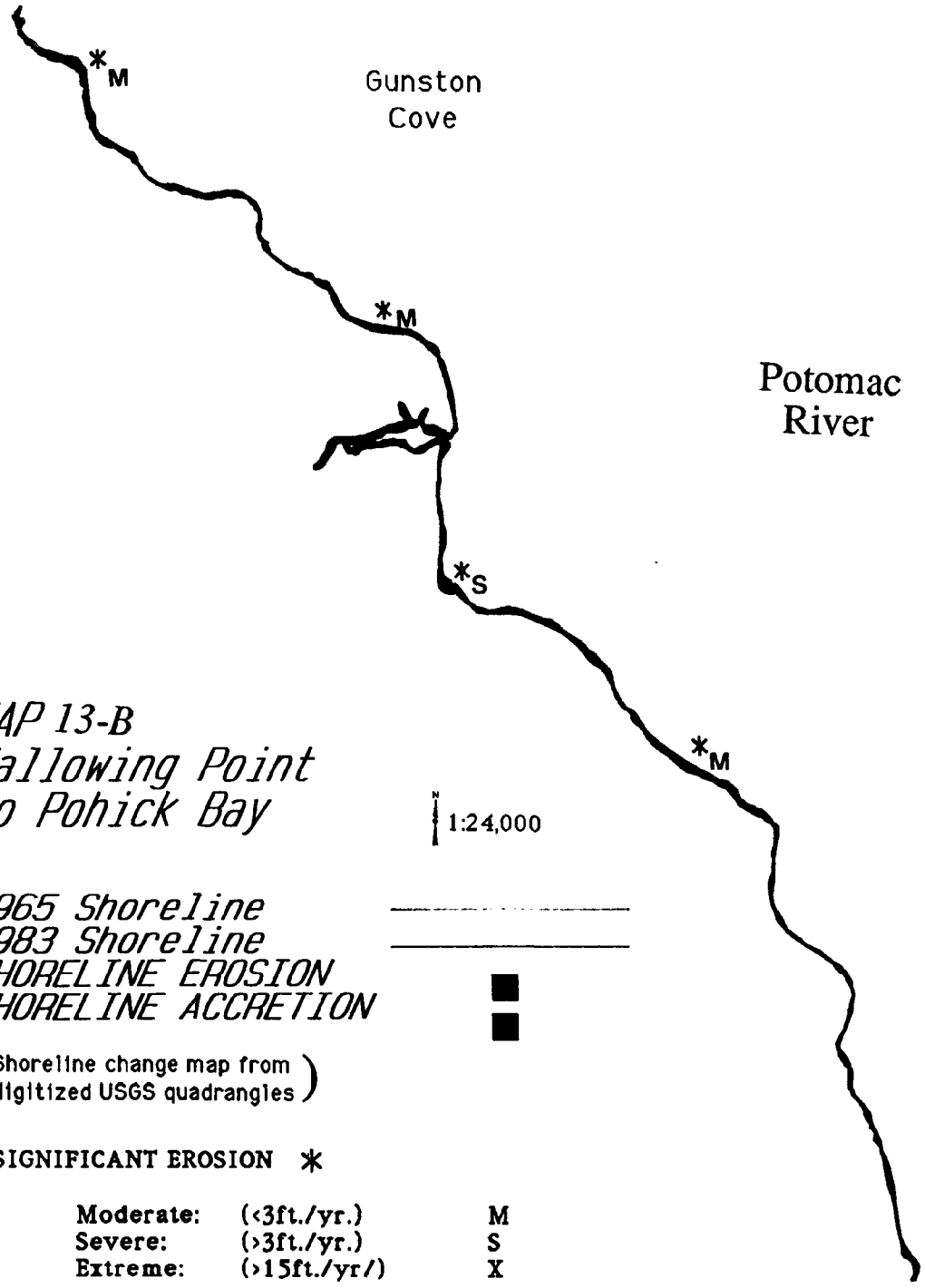
Erosion Situation:
The shoreline changes map shows that moderate (<3 ft/yr) bluff erosion has occurred in several places along this segment. The bluff erosion in the Gunston Manor residential area could threaten the houses that are close to the shoreline. Owen *et al.*, 1979, indicated that this segment is undergoing moderate (1 to 3 ft/yr) erosion from Hallowing Point to the inside of Gunston Cove, and that one house at the mouth of Gunston Cove is endangered by the erosion situation.

Artificial Stabilization:
Only 12% of this segment has been artificially stabilized with .5 mile of bulkhead (55%), riprap (40%), and several groins (5%). Most of the structures are along individual properties of Hallowing Point Estates and Gunston Manor with some gaps between structures. There is also some riprap near the Pohick boat ramp.



Map 13-A **Hallowing Point to Pohick Bay** 1:24,000

FX *(Fort Belvoir)*-Reference map from USGS Topo Quadrangles-



MAP 13-B
Hallowing Point
to Pohick Bay

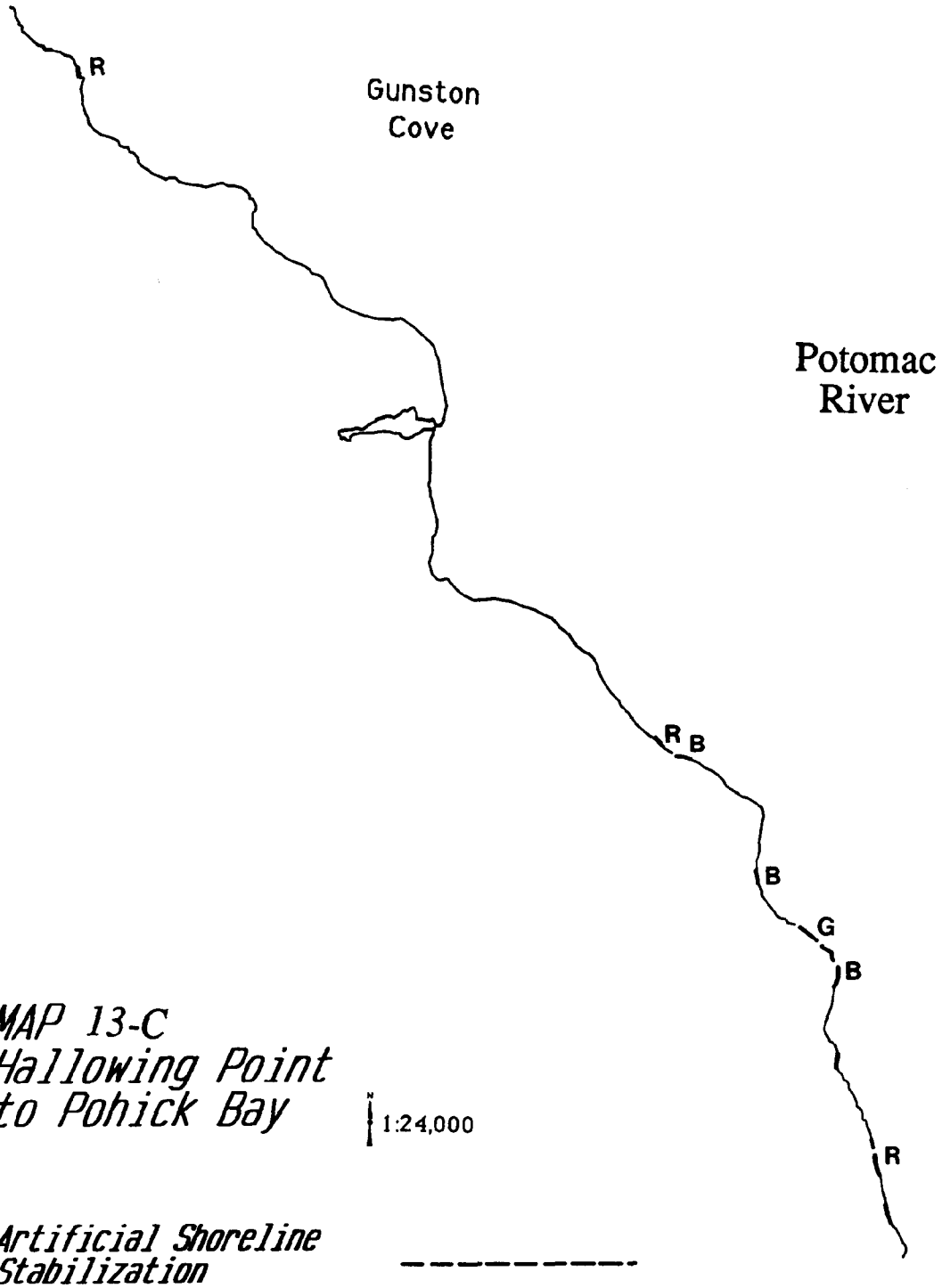
1:24,000

1965 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



MAP 13-C
Hallowing Point
to Pohick Bay

1:24,000

Artificial Shoreline Stabilization ---------

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 14

Shoreline Segment: Pohick Bay to Whitestone Point

USGS Quadrangle: Fort Belvoir

County: Fairfax

Property Maps: 114-4, 114-2, 115-1, 115-3, 115-4

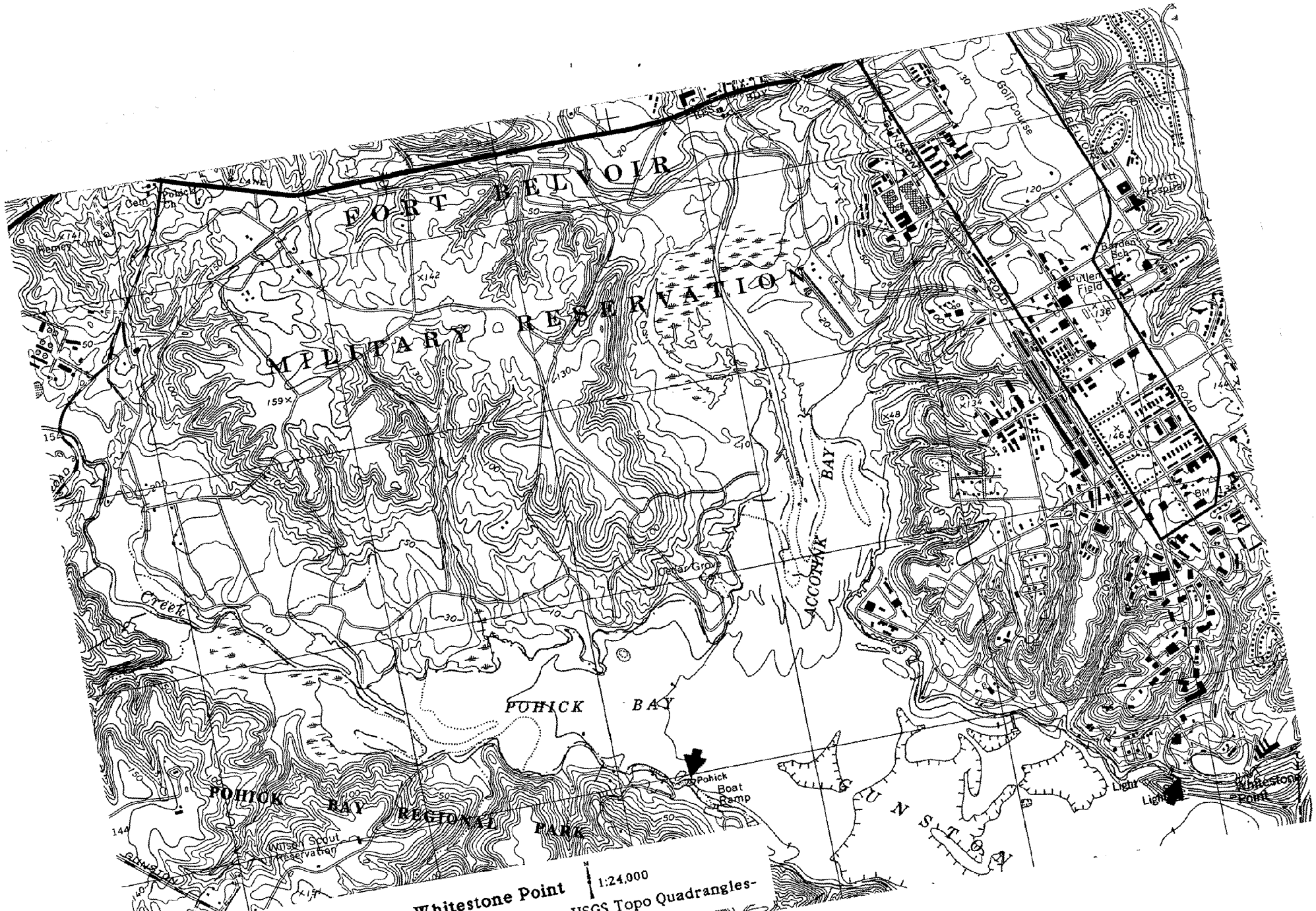
Water Bodies: Pohick Bay
Pohick Creek
Accotink Bay
Accotink Creek
Gunston Cove

Shoreline Description:
There are 16.6 miles of shoreline included from Pohick Bay to Whitestone Point. The shoreline in this segment is highly convoluted and only about half of the total shoreline is on Pohick Bay, Accotink Bay, and Gunston Cove. The limit of tidewaters along Pohick and Accotink Creeks is further inland than the portions included in this segment. Approximately 4.4 miles of shoreline are along Pohick Bay, and 1.8 miles are included along Pohick Creek. Approximately 2.1 miles are along Accotink Bay and 6.4 miles are along Accotink Creek, with 2.1 miles of that being island shorelines. The remaining 1.8 miles of shoreline are along Gunston Cove.

The first stretch of shoreline in this segment is along Pohick Bay regional park. The remainder of the shoreline is along the U.S. Army Fort Belvoir Military Reservation. There are a few residential buildings, and several buildings on the military base along the shoreline, but most of the shoreline is undeveloped. There are several docks and boat ramps in Gunston Cove.

Erosion Situation:
The shoreline changes map shows that there has been some moderate (< 3 ft/yr) erosion at the mouth of Pohick Bay, and near the Fort Belvoir military boat facility.

Artificial Stabilization:
Only 4% of this shoreline in this segment has been artificially stabilized with .6 mile of breakwater (50%), bulkhead (30%), and riprap (20%). There is a small section of bulkhead and some riprap to the northwest of the Pohick boat ramp. There is a large breakwater and some bulkheading at the Fort Belvoir military boat facility. There is also a dock and a stretch of bulkhead along the shoreline along Gunston Cove.



Map 14-A **Pohick Bay to Whitestone Point**

(Fort Belvoir)-Reference map from USGS Topo Quadrangles-

MAP 14-B
Pohick Bay to Whitestone Point

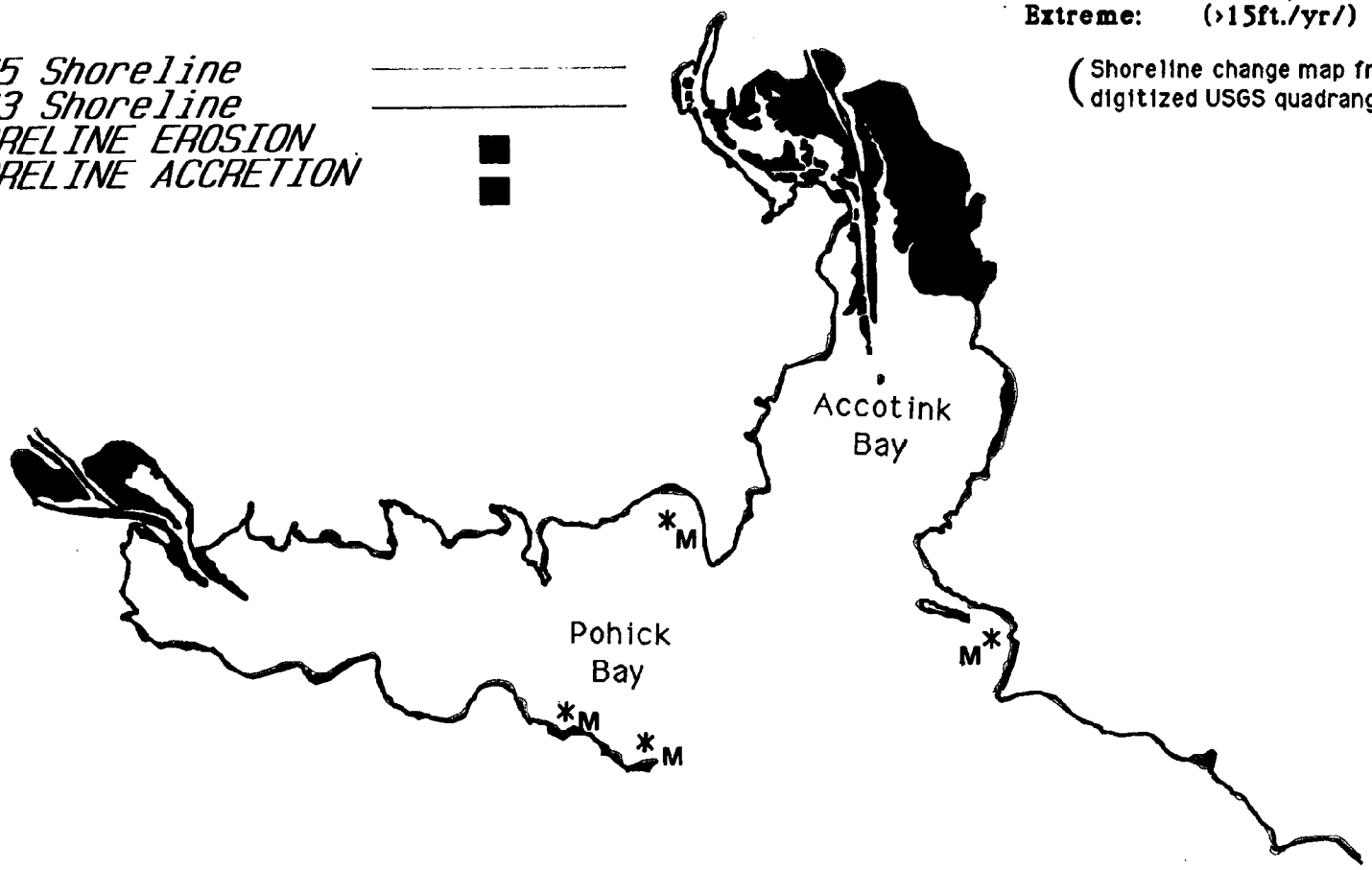
1:24,000

1965 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**

(Shoreline change map from digitized USGS quadrangles)



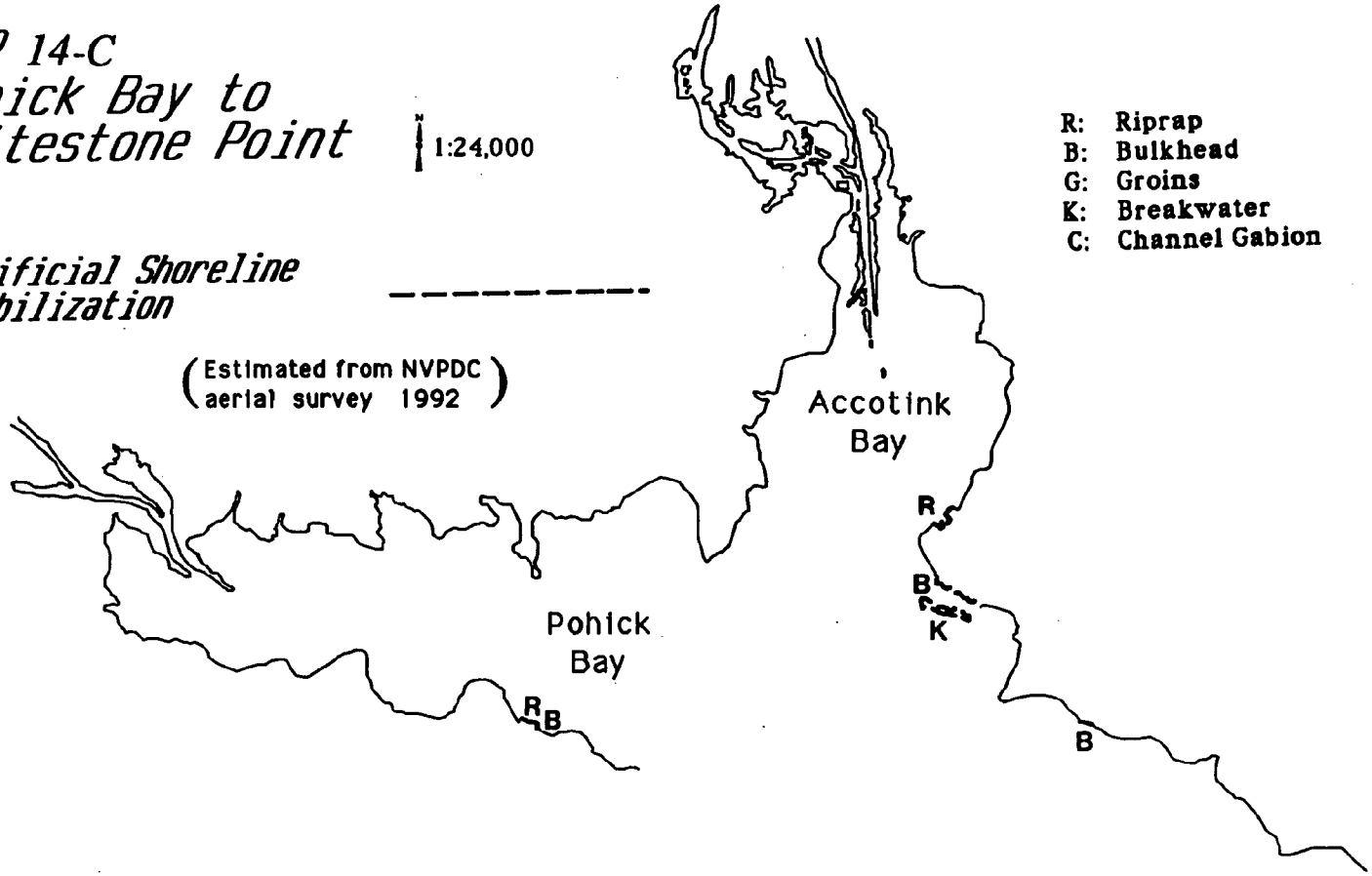
MAP 14-C
Pohick Bay to Whitestone Point

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion



MAP 15

Shoreline Segment: Whitestone Point to Ferry Point

USGS Quadrangles: Fort Belvoir
Mount Vernon

County: Fairfax

Property Maps: 115-4, 115-2, 109-4, 110-3

Water Bodies: Potomac River
Dogue Creek

Shoreline Description:
There are 8.1 miles of shoreline from Whitestone Point to Ferry Point. Around 1.9 miles lies directly on the Potomac and 4.9 miles are on Dogue Creek. The basin at Whitestone Point encompasses another 0.6 mile, and the basin at the Mount Vernon Yacht Club includes another 0.7 mile.

The shoreline from Whitestone Point to the head of Dogue Creek is all adjacent to the U.S. Army Fort Belvoir Military Reservation. There are only a few buildings near the shore. There is a boat ramp and docking facility on the upper northeast side of Dogue Creek on the military reservation. From the lower northeast side of Dogue Creek to Ferry Point, there are numerous residential areas including Mount Vernon Terrace, Mount Vernon on the Potomac, Yacht Haven Estates, and Oxford. The Mount Vernon Yacht Club is in this section. There are numerous piers and docks along this stretch.

Erosion Situation:
The shoreline changes map shows that there has been moderate (< 3 ft/yr) along several bluffs on both sides of Dogue Creek. The shoreline has also changed in several marsh areas; the shifting marsh shorelines are probably due to vegetation changes and meandering channels rather than large sediment fluxes. There have also been moderate (< 3 ft/yr) shoreline changes in both the basin at Whitestone Point and the basin at the Mount Vernon Yacht Club. The slight to moderate accretion to the north of Whitestone Point has occurred along the base of eroding bluffs. Owens *et al.*, 1979, indicated that the bluffs to the north of Whitestone Point are experiencing moderate (1 to 3 ft/yr).

Artificial Stabilization:
Overall, 41% of the shoreline in this segment has been artificially stabilized with 3.3 miles of bulkhead (60%) and riprap (40%). The Fort Belvoir Military Reservation has hardened shorelines at the basin at Whitestone Point, which has riprap on either side and bulkhead inside; there is a stretch of bulkhead south of Dogue Creek; and also some riprap on the north bank of the creek. The remaining shoreline on the north side of Dogue Creek is almost entirely structured with alternating bulkheading and riprap.

Map 15-A **Whitestone Point to Ferry Point** 1:24,000

FX *(Fort Belvoir, and Mount Vernon)*

-Reference map from USGS Topo Quadrangles-

MAP 15-B
Whitestone Point to Ferry Point

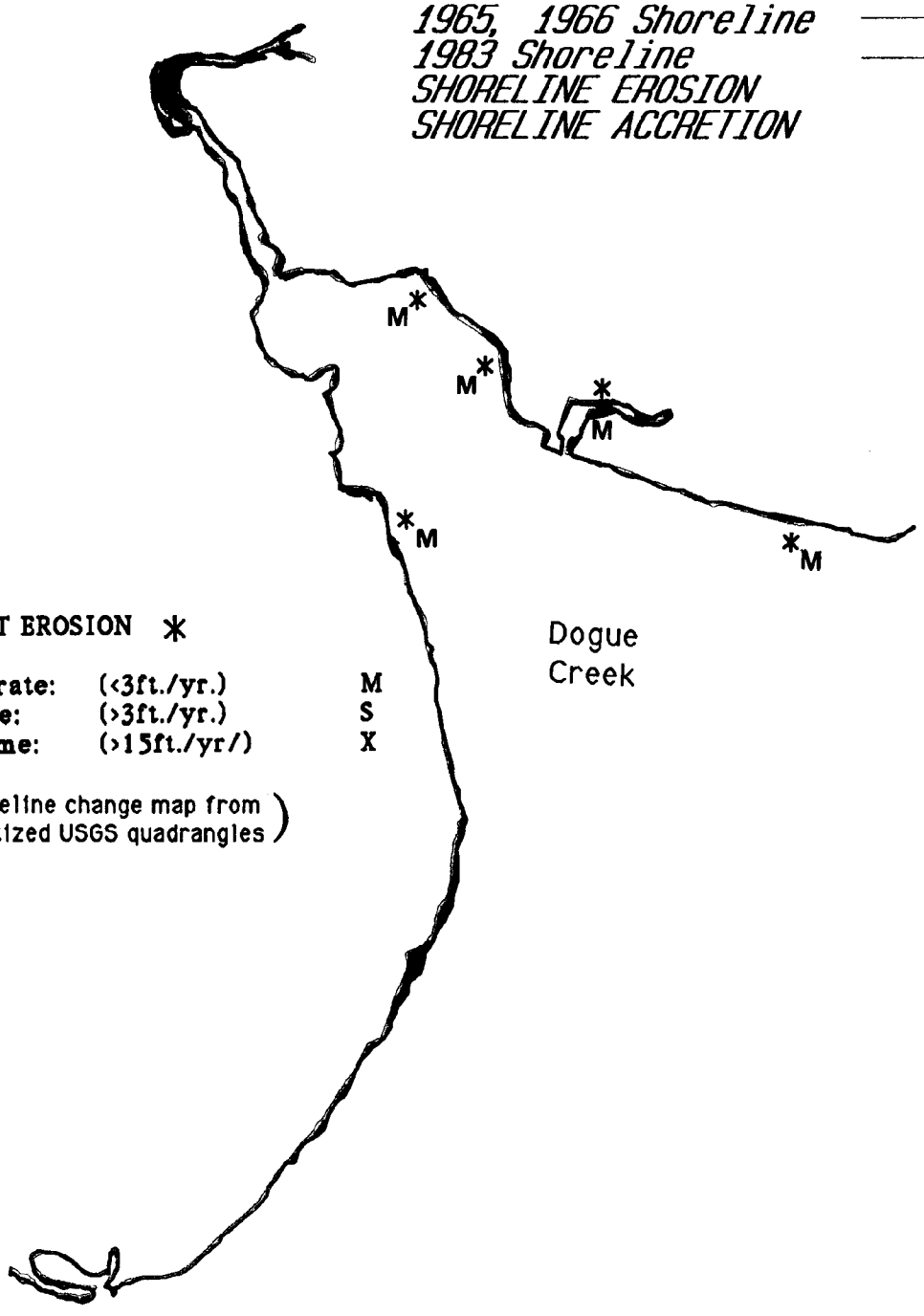
1:24,000

1965, 1966 Shoreline

1983 Shoreline

SHORELINE EROSION

SHORELINE ACCRETION



SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**

(Shoreline change map from digitized USGS quadrangles)

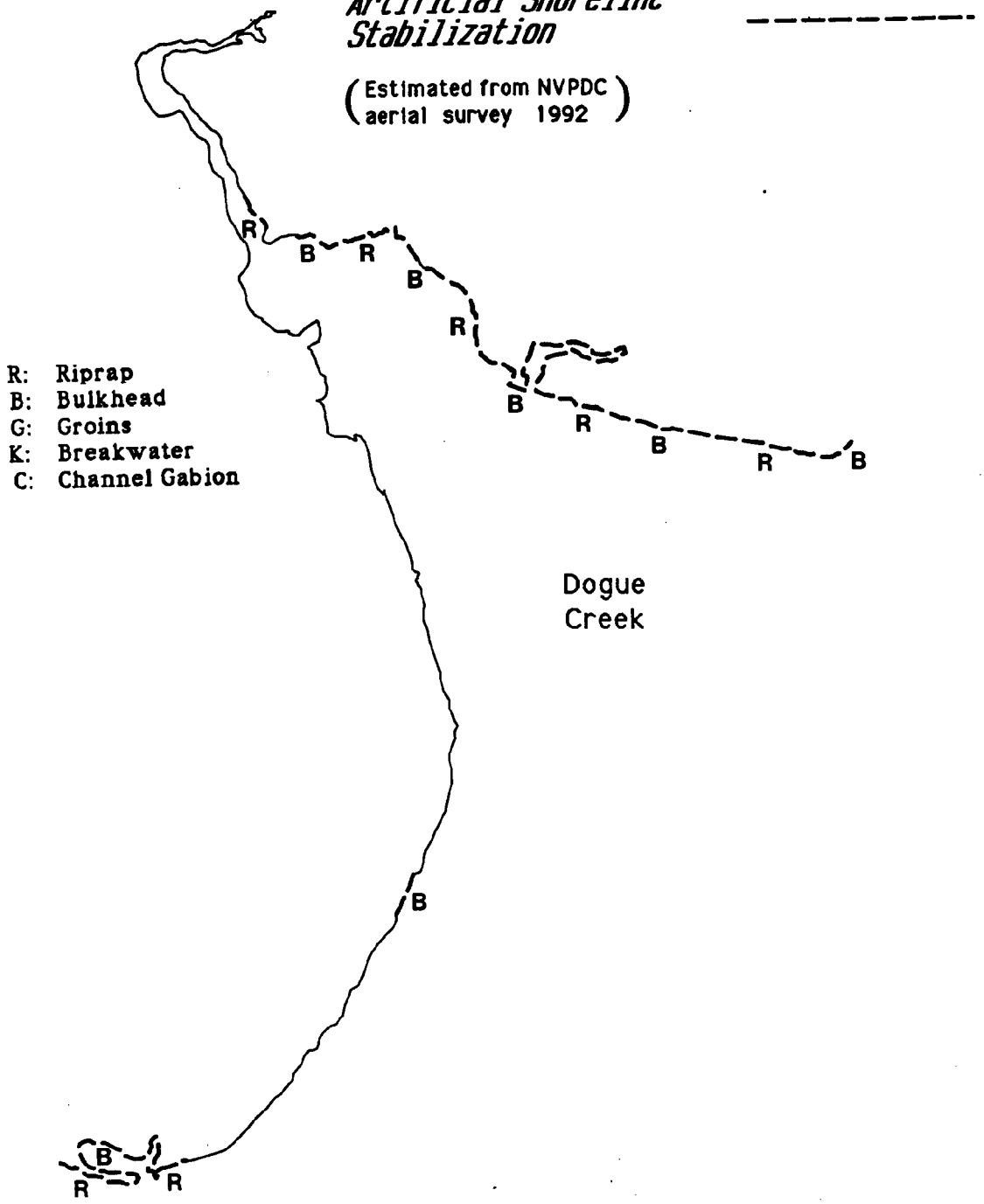
Dogue Creek

MAP 15-C
Whitestone Point to Ferry Point

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)



R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

Dogue Creek

MAP 16

Shoreline Degment: Ferry Point to Little Hunting Creek

USGS Quadrangle: Mount Vernon

County: Fairfax

Property Maps: 110-3, 110-4, 111-3, 111-1, 102-3

Water Bodies: Potomac River
Little Hunting Creek

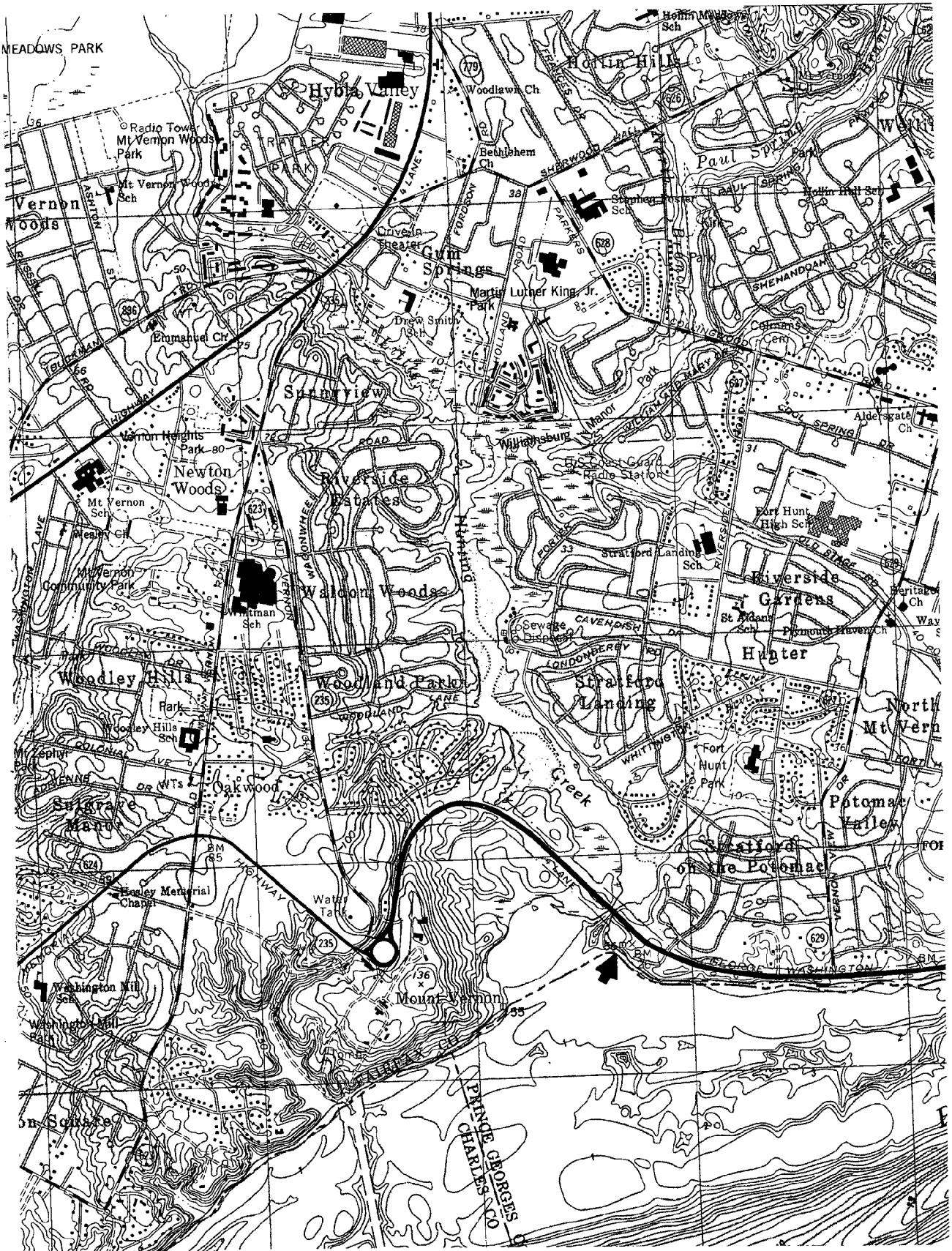
Shoreline Description:
There are 11 miles of shoreline from Ferry Point to Little Hunting Creek. Approximately 1.8 miles of shoreline are on the Potomac River and the remaining 9.2 miles are along Little Hunting Creek.

Northeast of Ferry point are the Belle River and Riverwood residential areas and the Mansion House Yacht Club. The stretch of shoreline beyond these residential areas and around the western side of the mouth of Little Hunting Creek is along the historic Mount Vernon estate. There are numerous residential areas along Little Hunting Creek including Wessynton, Woodland Park, Waldon Woods Riverside Estates, Sunnyview, Huntington at Mount Vernon, Stratford Landing, Fort Hunt, and Stratford on the Potomac. There are also a sewage disposal area, a U.S. Coast Guard Radio Station, the Martin Luther King Jr. Park, the Williamsburg Manor Park and the Little Hunting Creek Park on Little Hunting Creek. The George Washington Memorial Parkway and the Mount Vernon Bike Trail cross Little Hunting Creek near the mouth. The shoreline at the end of this segment is Riverside Park along the George Washington Memorial Parkway.

Erosion Situation:
The shoreline changes map shows that moderate (< 3 ft/yr) to severe (>3 ft yr) erosion has taken place along Stratford on the Potomac residential area at the mouth of Little Hunting Creek. The map also shows other shoreline changes near the mouth of, and along Little Hunting Creek, that are mainly associated with marsh shorelines; and therefore, probably due to vegetation changes and meandering channels, rather than large sediment fluxes.

Owens *et al.*, 1979, indicated that the bluffs to the north of Ferry Point are experiencing moderate (1 to 3 ft/yr) erosion.

Artificial Stabilization:
There are 1.7 miles of artificial shoreline stabilization in this segment along 15% of the shoreline. Approximately 60% of the structures are bulkheading and 40 % are riprap. There is riprap just to the north of Ferry Point and near Mount Vernon. Most of the bulkheading is in Little Hunting Creek.

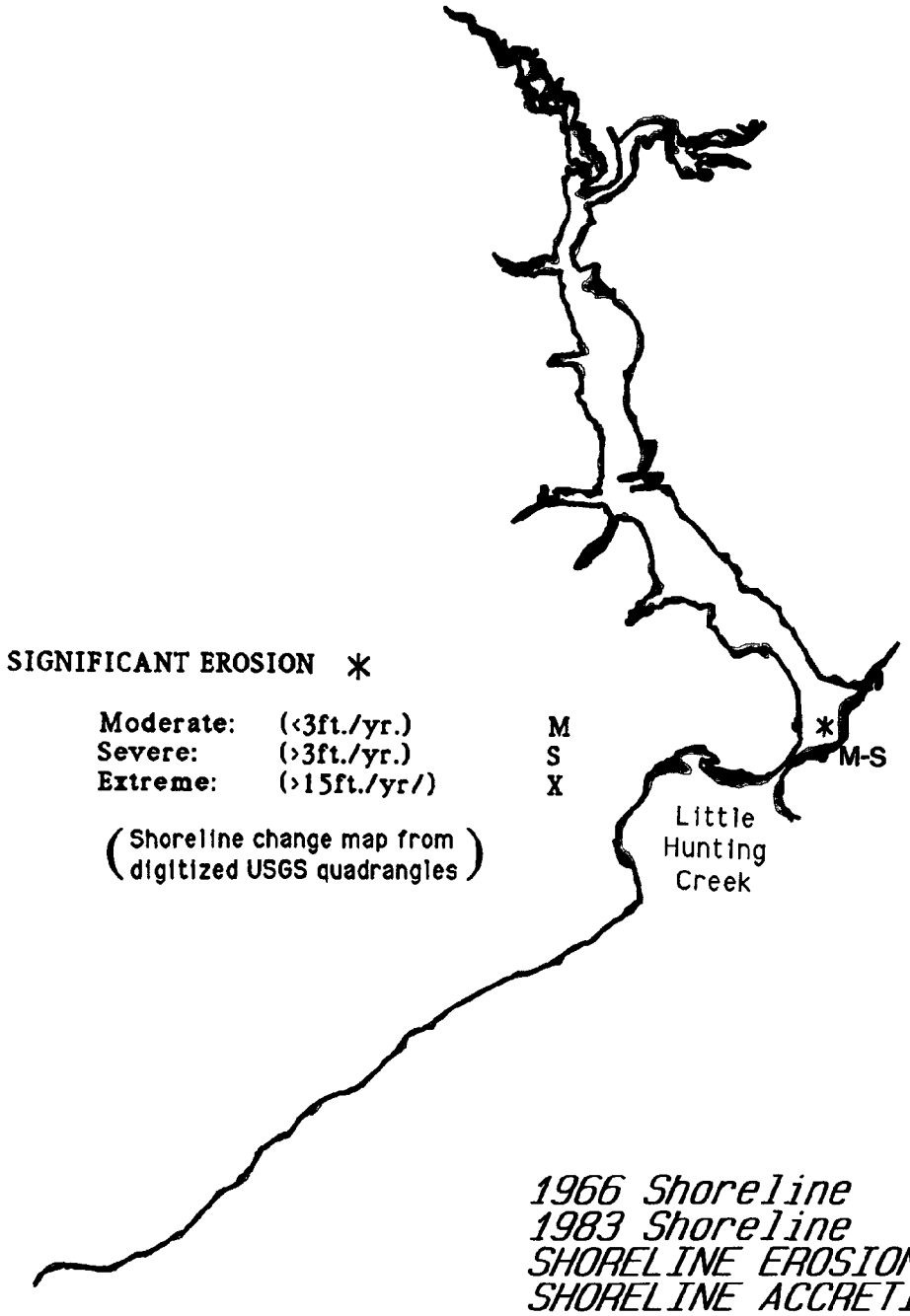


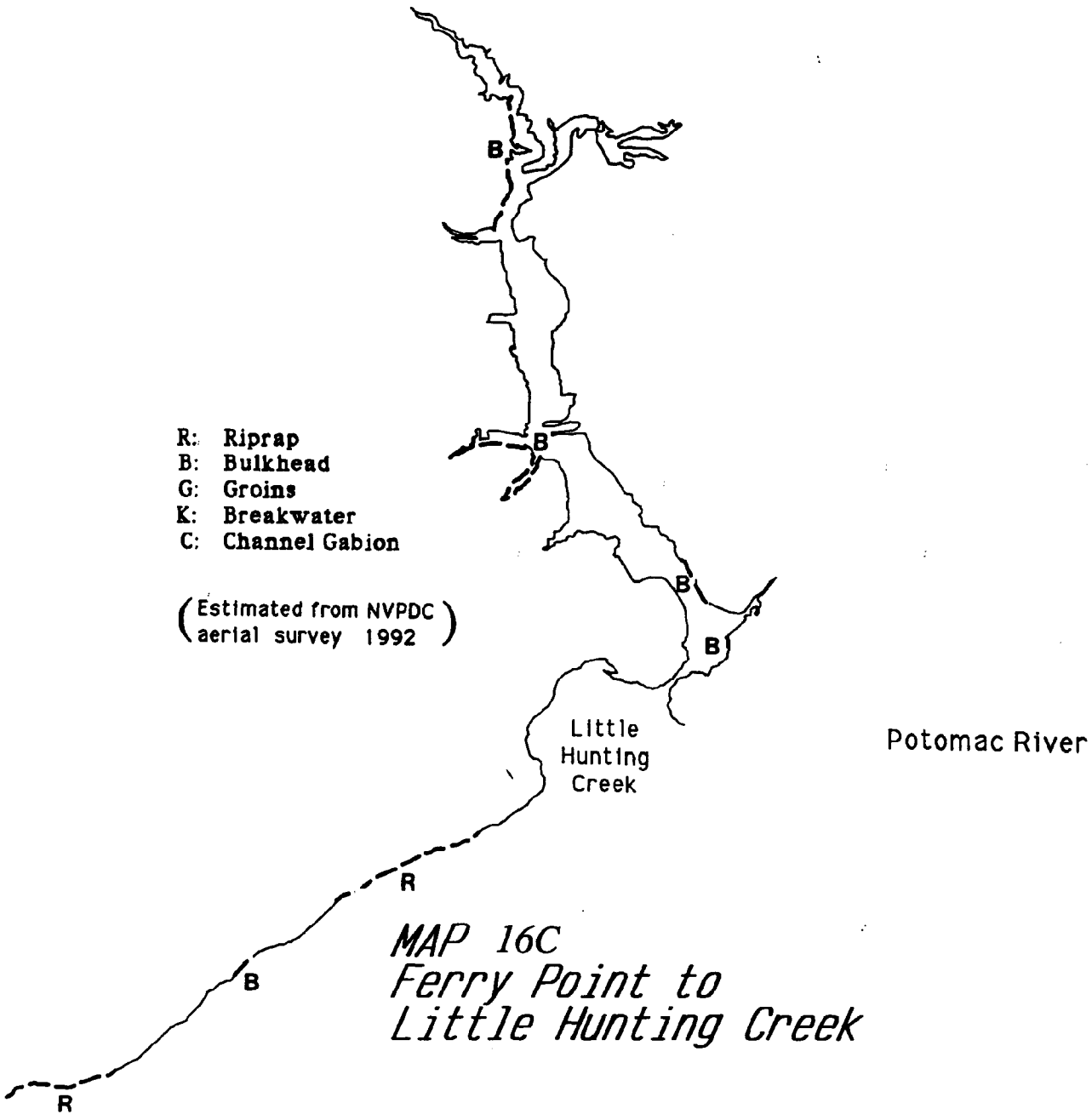
Map 16-A **Ferry Point to Little Hunting Creek** 1:24,000

FX *(Mount Vernon)*-Reference map from USGS Topo Quadrangles-

MAP 16-B
Ferry Point to Little Hunting Creek

1:24,000





MAP 16C
Ferry Point to Little Hunting Creek

Artificial Shoreline Stabilization ----------

MAP 17

Shoreline Segment: Little Hunting Creek to Hog Island

USGS Quadrangles: Alexandria
Mount Vernon

County: Fairfax

Property Maps: 111-1, 111-2, 102-4, 102-2

Water Body: Potomac River

Shoreline Description:
There are 4.4 miles of shoreline from Little Hunting Creek to Hog Island. The entire segment runs along a bend in the Potomac River.

The shoreline starts at Riverside park and continues along the George Washington Memorial Parkway past Fort Hunt around Sheridian Point. The National Park Service land continues around the bend in the Potomac River up to the residential areas of Collingwood, Herbert Springs, Arcturus, and Wellington Villa, which are adjacent to the shoreline at the end of the segment.

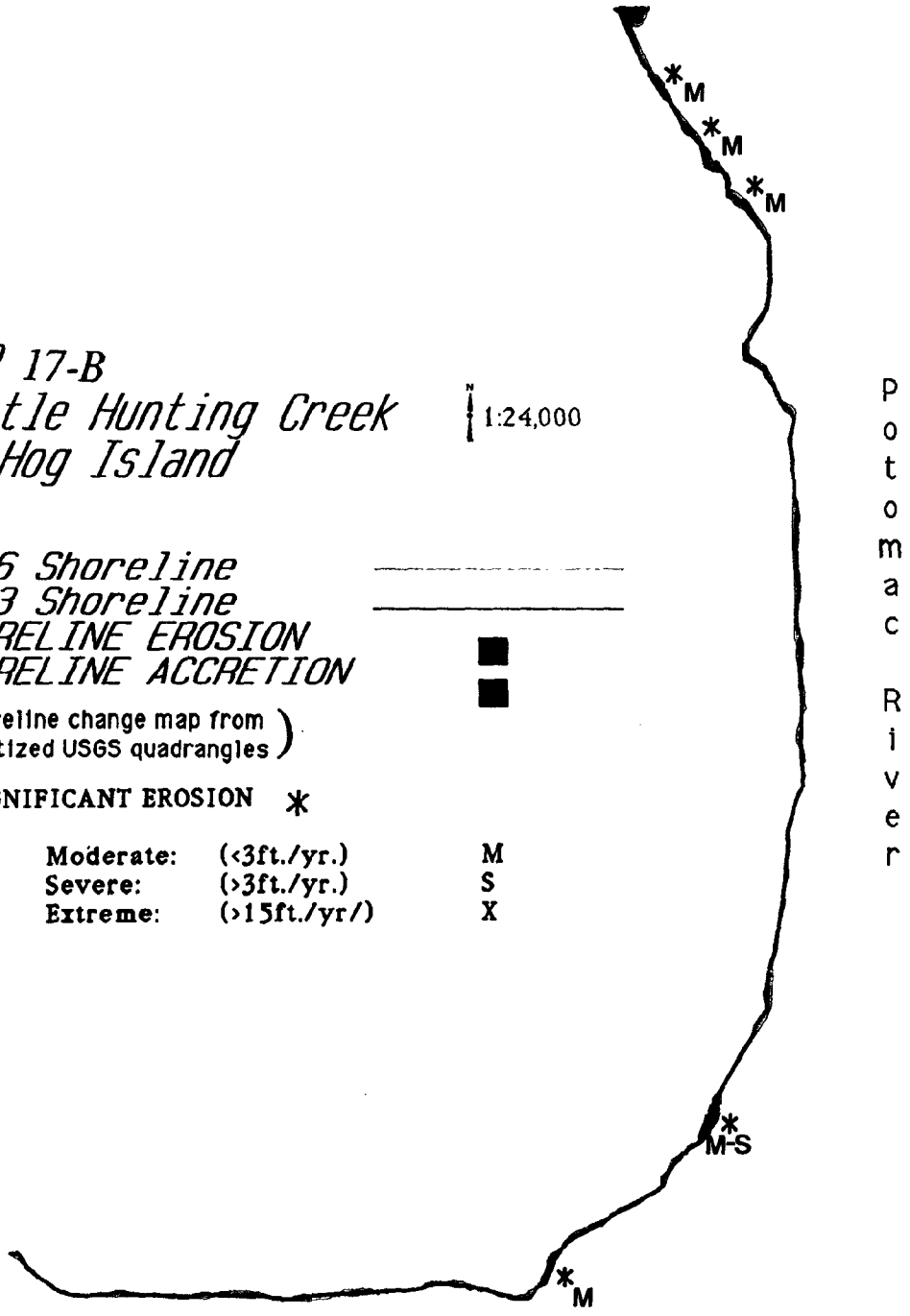
Erosion Situation:
The shoreline changes map shows that moderate (< 3 ft/yr) to severe (>3 ft/yr) erosion has taken place to the north of Sheridan Point. There has also been some moderate erosion (<3 ft/yr) along the shoreline to the north of Arcturus. The erosion at the very north end of the segment is related to the marsh changes around Hog Island.

Artificial Stabilization:
There are 2.0 miles of artificial shoreline stabilization along 46% of the shoreline in this segment. 70% of the shoreline armoring is riprap and the remaining 30% is bulkheading. There are some areas with riprap along the George Washington Memorial Parkway. The residential areas have a mix of bulkheading and riprap, but not all of the properties have shoreline armoring.

Map 17-A **Little Hunting Creek to Hog Islan** 1:24,000

FX *(Alexandria and Mount Vernon)*

-Reference map from USGS Topo Quadrangles-



MAP 17-B
Little Hunting Creek to Hog Island

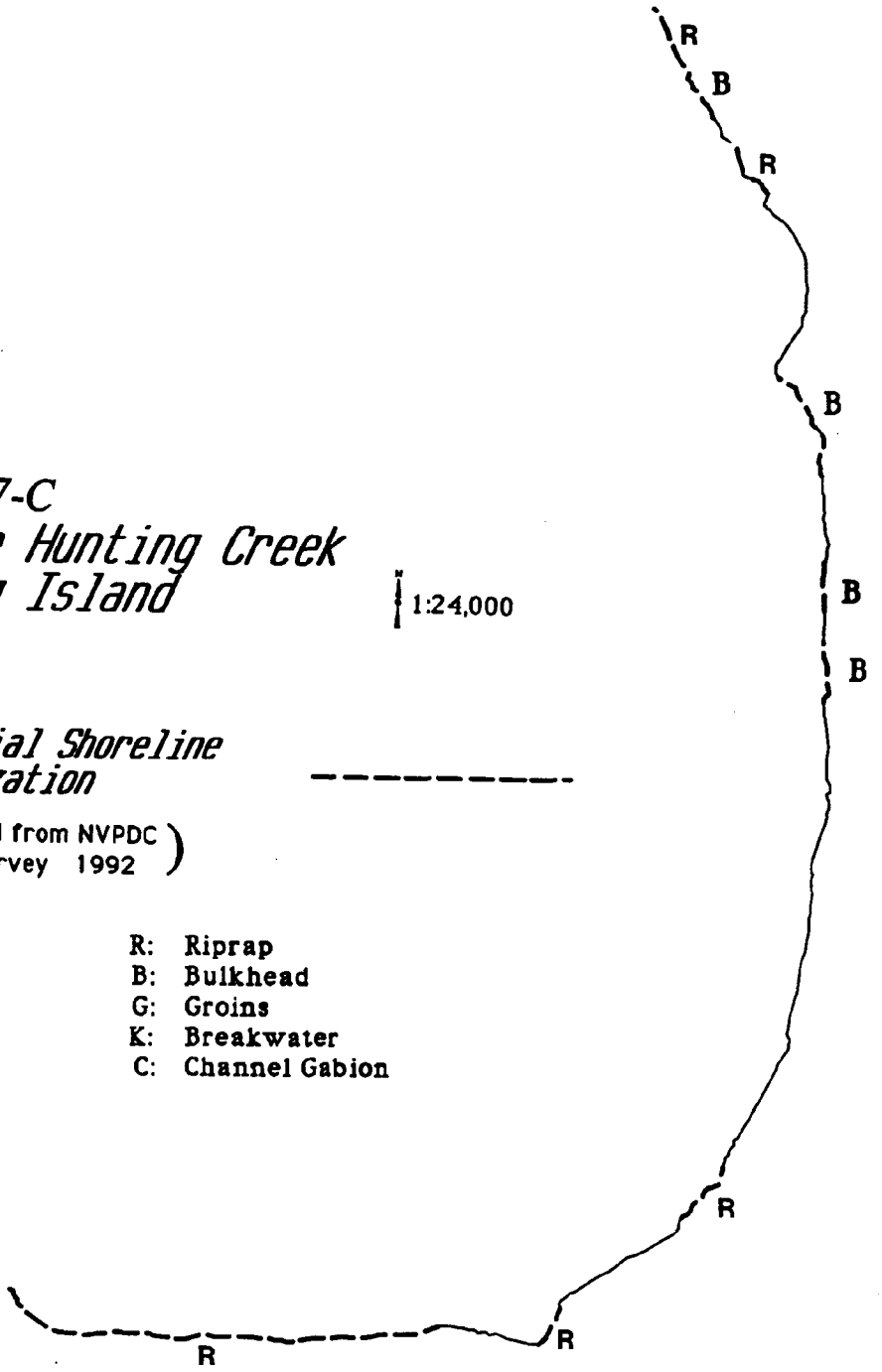
1:24,000

1966 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**



MAP 17-C
Little Hunting Creek to Hog Island

1:24,000

Artificial Shoreline Stabilization

(Estimated from NVPDC aerial survey 1992)

R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion

MAP 18

Shoreline Segment: Hog Island to Hunting Creek

USGS Quadrangle: Alexandria

County: Fairfax

Property Maps: 102-2, 93-4, 93-2, 83-4, 83-2, 83-1

Water Bodies: Potomac River
Hunting Creek
unnamed tributaries

Shoreline Description:

There are 14.9 miles of shoreline from Hog Island to Hunting Creek. This shoreline segment ends at the jurisdictional boundary between the City of Alexandria and Fairfax County which is approximately at Hooff Run, 1.2 miles above the mouth of Hunting Creek. Hooff Run also marks the transition between Cameron Run to the west and Hunting Creek to the east. Approximately 4.4 miles of this segment lie directly on the Potomac River, 0.9 mile is on Hunting Creek, and 1.0 mile of the shoreline is along a tributary of Hunting Creek. The remaining 8.6 miles of shoreline are along unnamed channels in the large marsh area at the beginning of the segment.

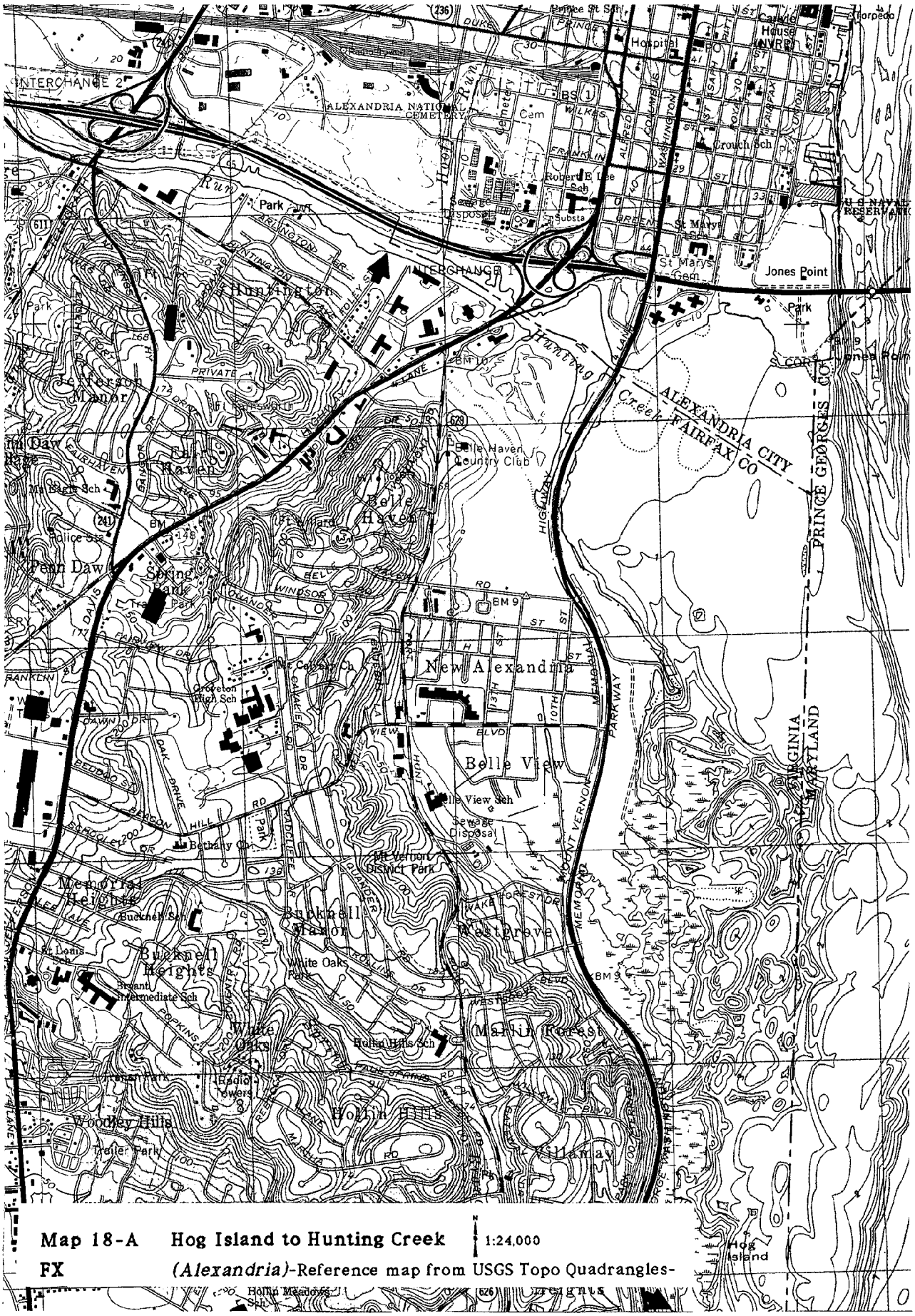
The entire stretch of shoreline from Hog Island to the mouth of Hunting Creek is along the George Washington Memorial Parkway. The Belle Haven boat ramp and marina is in this reach, just north of the large marsh area. The George Washington Memorial Parkway crosses Hunting Creek at its confluence with the Potomac. The tributary at the mouth of the Creek runs along the western side of the Parkway. The western side of the tributary and the first stretch of Hunting Creek border the Belle Haven Country Club. The shoreline along Hunting Creek also runs along the Grosvenor Riverside commercial areas where Route 1 crosses the creek. Tidal influence continues up Cameron Run to an undefined point prior to where Interstate-95 crosses the run.

Erosion Situation:

The shoreline changes map shows extreme (> 15 ft /yr) erosion in the marsh area; while some of the shifting marsh shorelines are probably due to vegetation changes and meandering channels, there also has been a loss of sediment along this stretch of the Potomac River. The marina to the north of the marsh has experienced severe erosion (> 3 ft/yr). The shoreline near the mouth of Hunting Creek has also experienced moderate (< 3 ft/yr) to severe (> 3 ft/yr) erosion. The strip of erosion just inside the Creek is land that used to be marsh and is now open water. Some moderate (< 3 ft/yr) erosion has also occurred along Hunting Creek.

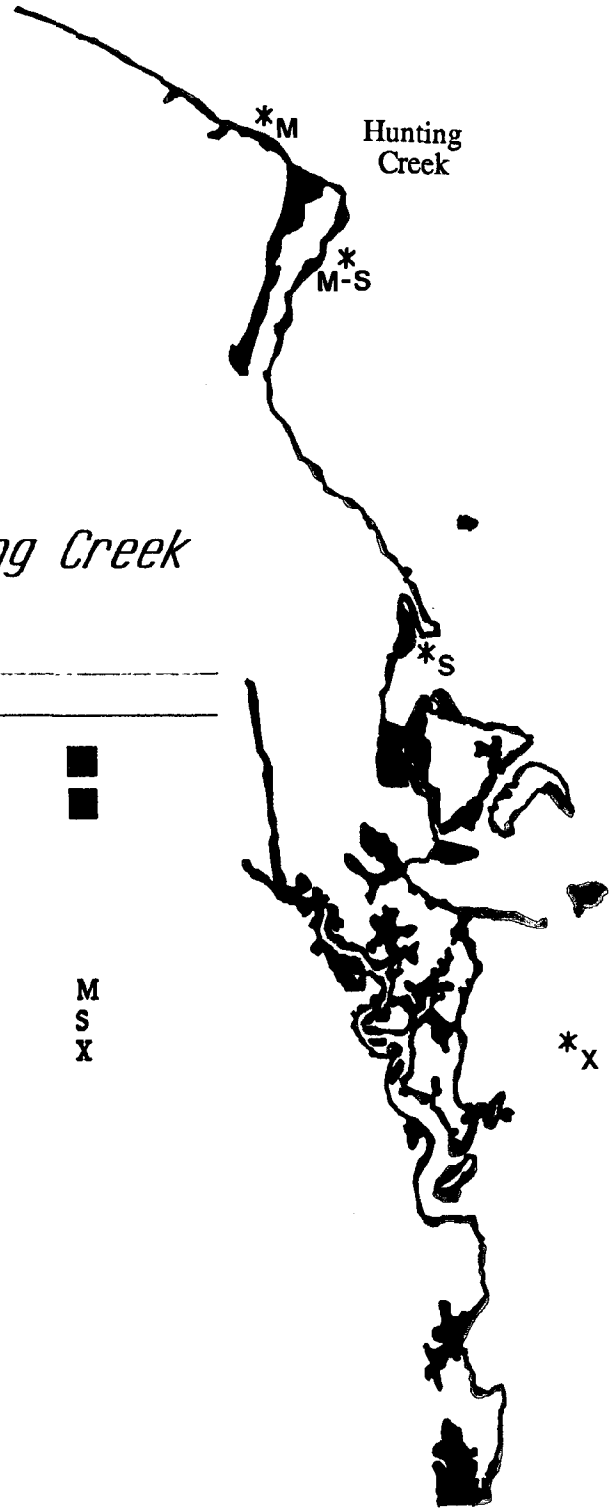
Artificial Stabilization:

Only 9% of the total shoreline in this segment has been artificially stabilized. 60% of the 1.4 mile shoreline armoring is riprap and 40% is bulkhead. There is a single section of bulkheading in Hunting Creek, and the remaining structures run from the marina above the marsh to near the entrance to the creek.



Map 18-A **Hog Island to Hunting Creek** 1:24,000

FX *(Alexandria)*-Reference map from USGS Topo Quadrangles-



1:24,000

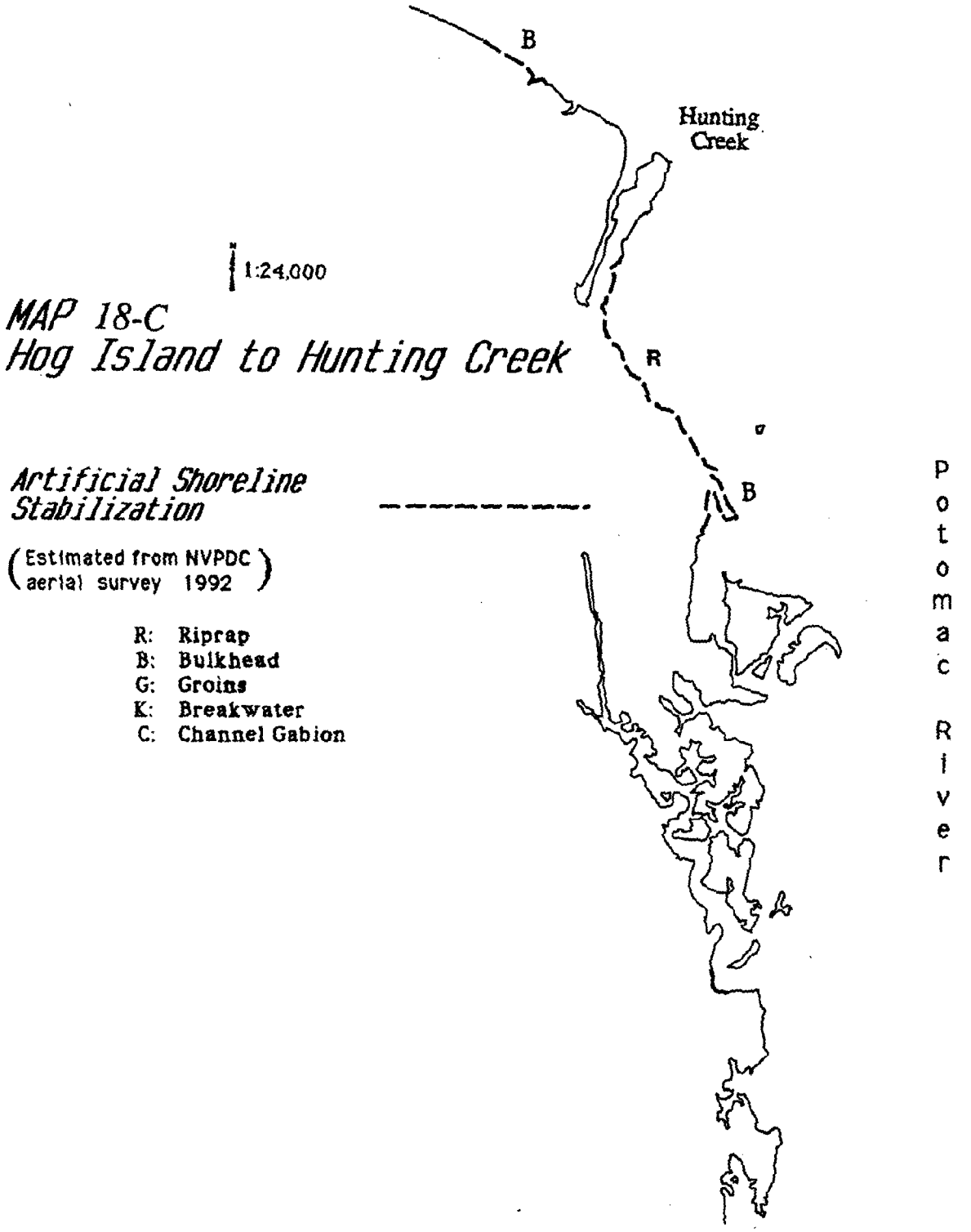
MAP 18-B
Hog Island to Hunting Creek

1971 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**


B
Hunting Creek
1:24,000
MAP 18-C
Hog Island to Hunting Creek
R
B
Artificial Shoreline Stabilization
(Estimated from NVPDC aerial survey 1992)
R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion
Potomac River

MAP 19

Shoreline Segment: Hunting Creek to Four Mile Run

USGS Quadrangle: Alexandria

City: Alexandria

Property Maps: 82.00, 83.01, 83.03, 83.04, 83.02, 84.01, 84.03, 81.03, 81.01, 75.03, 75.01, 65.03, 65.01, 55.03, 55.01, 36.00, 26.00, 17.00, 25.00, 16.00, 08.00

Water Bodies: Hooff Run
Hunting Creek
Potomac River
Four Mile Run

Shoreline Description:

There are 8.8 miles of shoreline from Hunting Creek to Four Mile Run. The segment begins at the jurisdictional boundary between the City of Alexandria and Fairfax County which is approximately at Hooff Run, 1.2 miles above the mouth of Hunting Creek. Approximately 0.7 mile of shoreline is included along Hooff Run. The shoreline extends for 6.6 miles along the Potomac River, and another 0.3 mile along Four Mile Run. This shoreline segment ends at the jurisdictional boundary between the City of Alexandria and Arlington County, which occurs approximately at the Route 1 bridge.

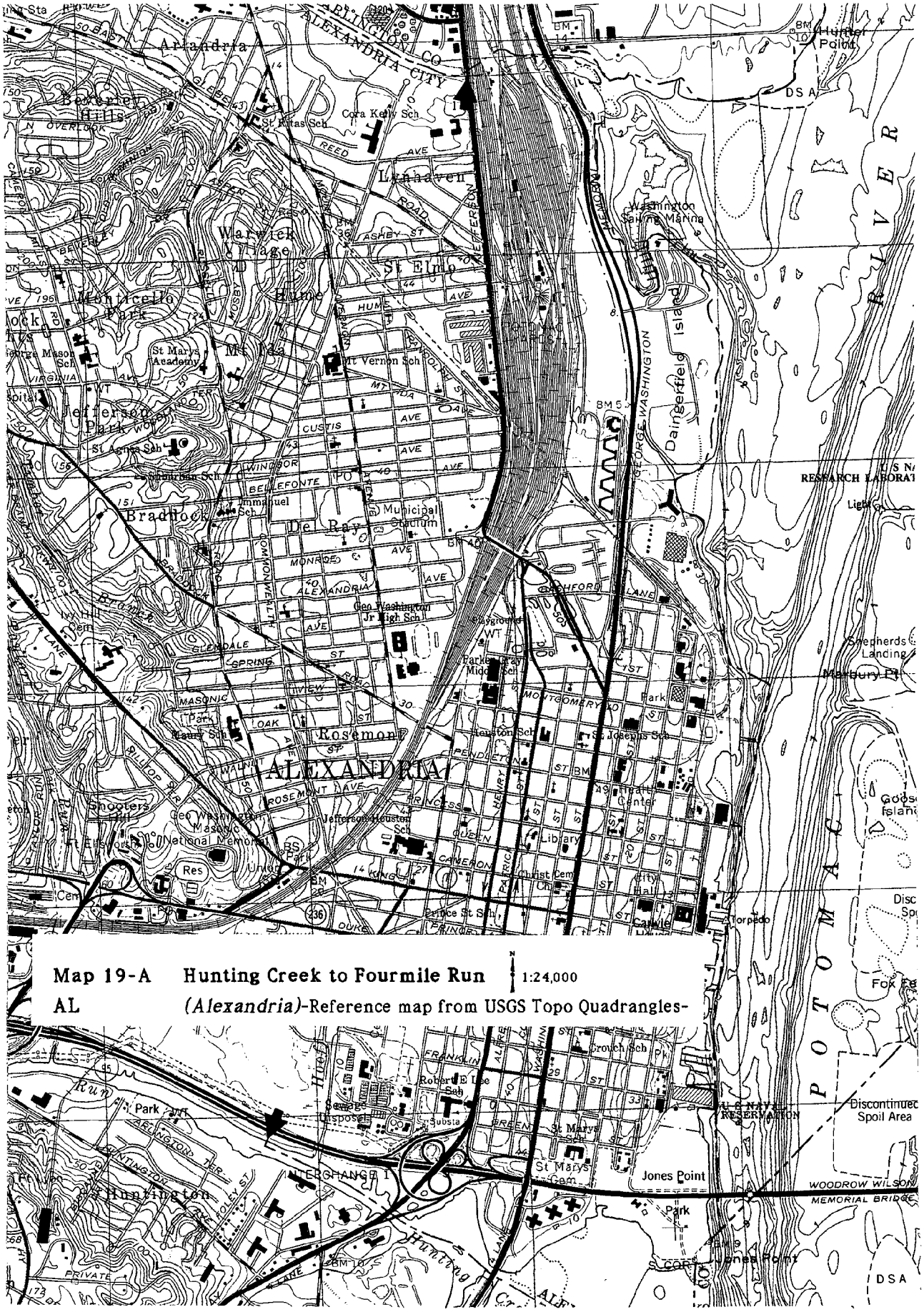
The shoreline at Hooff Run is crossed by Interstate-95, and the shoreline along Hunting Creek is crossed by Route 1 and the George Washington Memorial Parkway, which becomes Washington Street on the Alexandria side of the creek. The shorelands along this segment are industrial and residential. There are several large apartment buildings near the shoreline at the mouth of Hunting Creek called Hunting Towers. The Potomac shoreline begins at Jones Point near the Jones Point Lighthouse. This segment covers the entire waterfront of the City of Alexandria, and continues past Dangerfield Island to the mouth of Four Mile Run. There are many piers and docks, and several boat ramps in this section. The waterfront is extensively developed with a combination of recreational, industrial, and commercial uses. The Four Mile Run shoreline is mainly occupied by the Route 1, multiple railroad, and George Washington Memorial Parkway bridges.

Erosion Situation:

The shoreline changes map shows that large shoreline changes have occurred along Four Mile Run; this is due to the channelization done by the Army Corps of Engineers as a flood control measure and therefore does not represent an erosional trend. There are five small areas where the shoreline has changed moderately (< 3 ft/yr) to severely (>3 ft/yr).

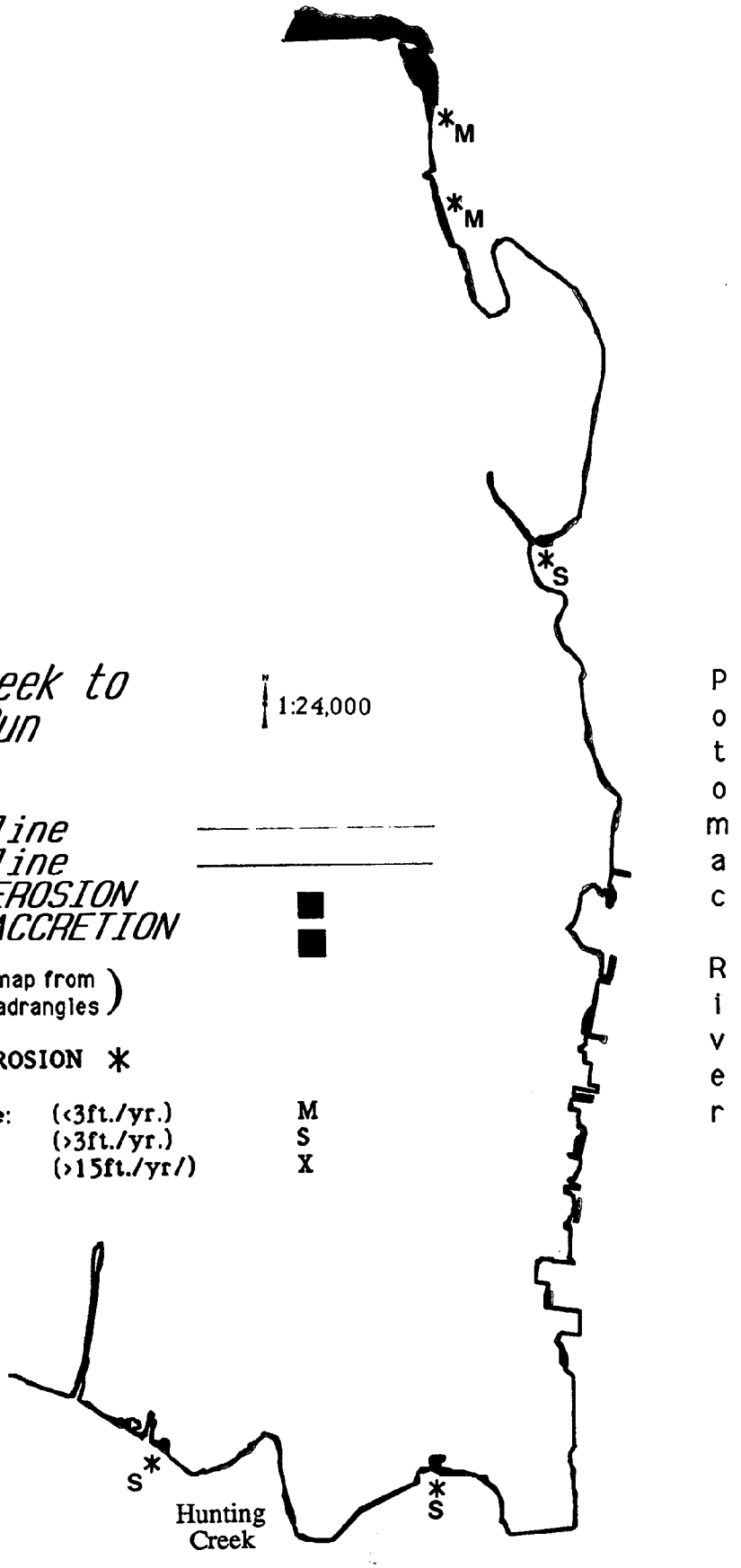
Artificial Stabilization:

Overall, 58% of the shoreline in this segment has been artificially stabilized. Of the 5.1 miles of shoreline armoring, 75% is riprap, 20% is bulkhead, and the remaining 5% is channel gabion along Four Mile run. The bulkheading and riprap is spread out along most of the Alexandria waterfront, with only a few gaps.



Map 19-A **Hunting Creek to Fourmile Run** 1:24,000

AL *(Alexandria)*-Reference map from USGS Topo Quadrangles-



MAP 19-B
Hunting Creek to Fourmile Run

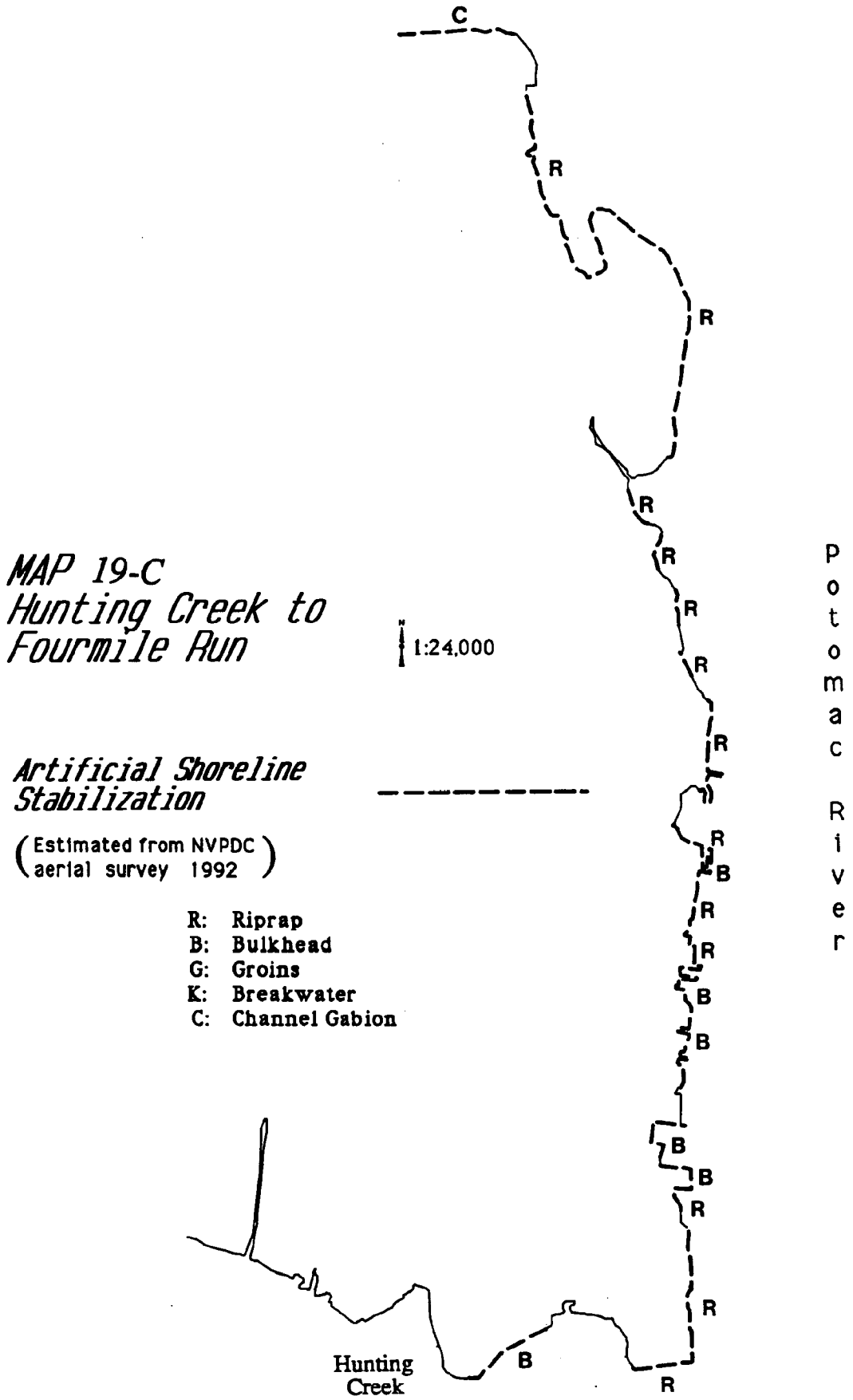
1:24,000

1971 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**


MAP 19-C
Hunting Creek to
Fourmile Run
1:24,000
Artificial Shoreline
Stabilization
(Estimated from NVPDC
aerial survey 1992)
R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion
Hunting
Creek
Potomac River

MAP 20

Shoreline Segment: Four Mile Run to Theodore Roosevelt Bridge

USGS Quadrangles: Washington West
Alexandria

County: Arlington

Property Maps: None (all Federal)

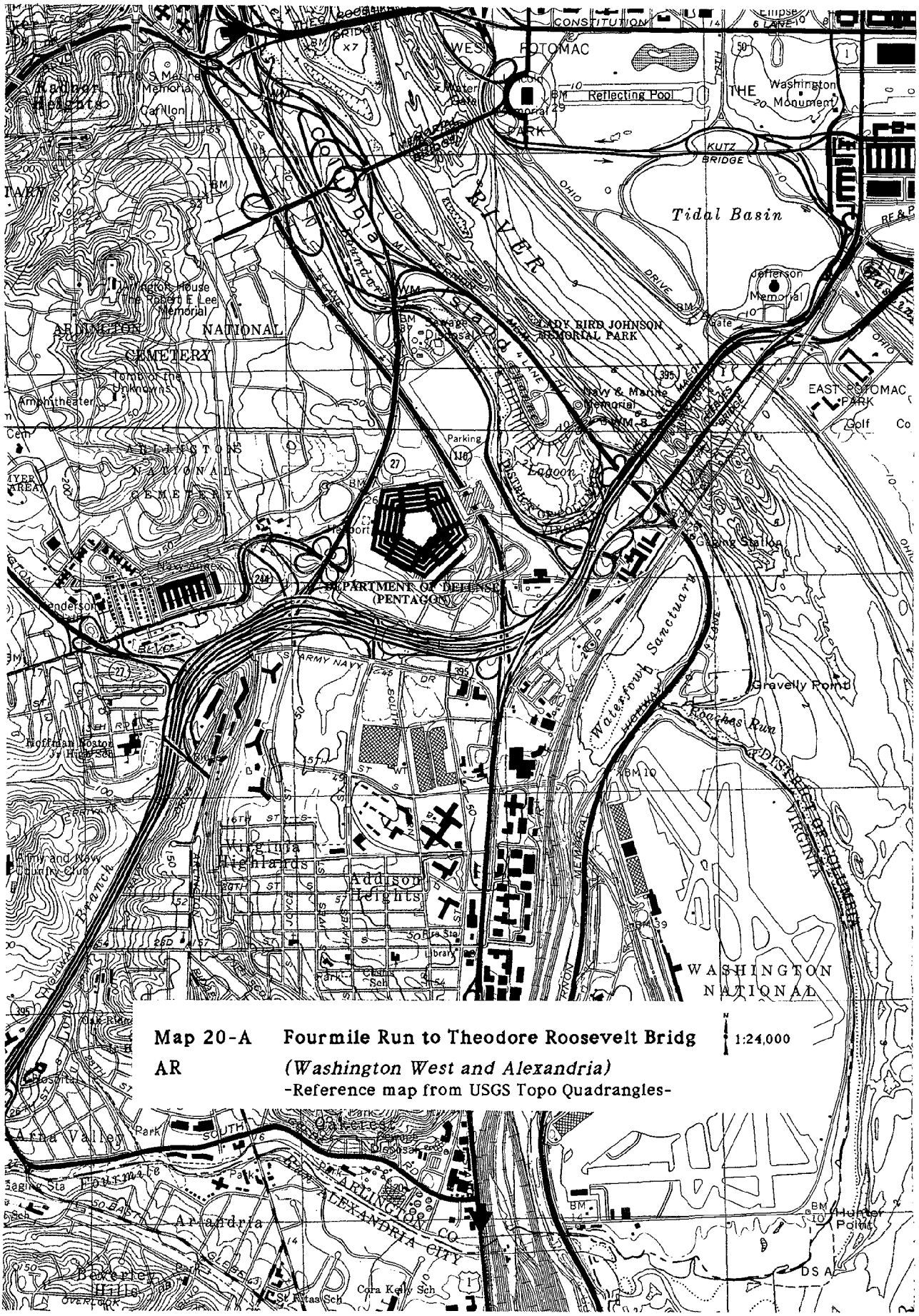
Water Bodies: Four Mile Run
Potomac River
Roaches Run and Waterfowl Sanctuary
Boundary Lagoon
Little River

Shoreline Description:
There are 8.3 miles of shoreline from Four Mile Run to Theodore Roosevelt Bridge. The first 0.5 mile runs along Four Mile Run under Route 1, multiple railroad, and George Washington Memorial Parkway bridges. The Washington National Airport is adjacent to 2.9 miles of shoreline along the Potomac, from the mouth of Four Mile Run to Roaches Run. Roaches Run and the Waterfowl Sanctuary have 2.2 miles of shoreline. The shoreline from the mouth of Roaches Run to the mouth of Boundary Lagoon extends for 1.0 mile along the Potomac River The remaining 1.6 miles of shoreline is mainly along Boundary Lagoon behind Columbia Island, with the exception of 0.1 mile before Theodore Roosevelt Bridge which is at the mouth of Little River.

All of the shoreline in this segment is controlled by the Federal Government. There is a sewage Disposal area on Boundary Lagoon. Numerous bridges cross the shoreline along this segment.

Erosion Situation:
The shoreline changes map shows that there are a few small areas of moderate (< 3 ft/yr) erosion in this segment. The map also shows severe (> 3 ft/yr) erosion around the Theodore Roosevelt Bridge.

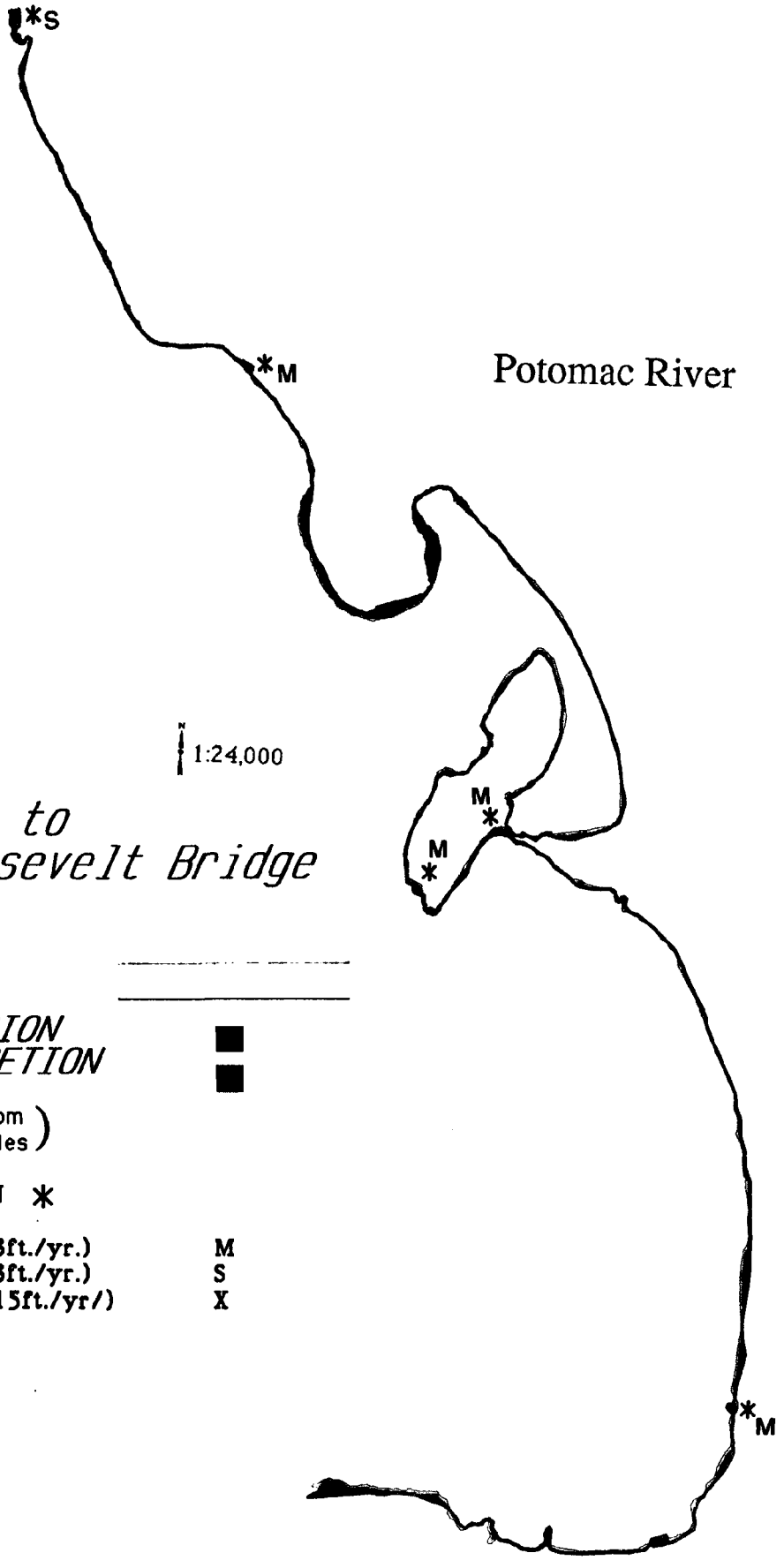
Artificial Stabilization:
Overall, 47% of the shoreline in this segment has been artificially stabilized with 3.9 miles of structures. Approximately 90% of the shoreline armoring is riprap at several locations throughout the segment, and the remaining 10% of the hardened shoreline is along the north side of Four Mile Run, which has been channelized with gabion.



Map 20-A **Fourmile Run to Theodore Roosevelt Bridg** 1:24,000

AR *(Washington West and Alexandria)*

-Reference map from USGS Topo Quadrangles-



1:24,000

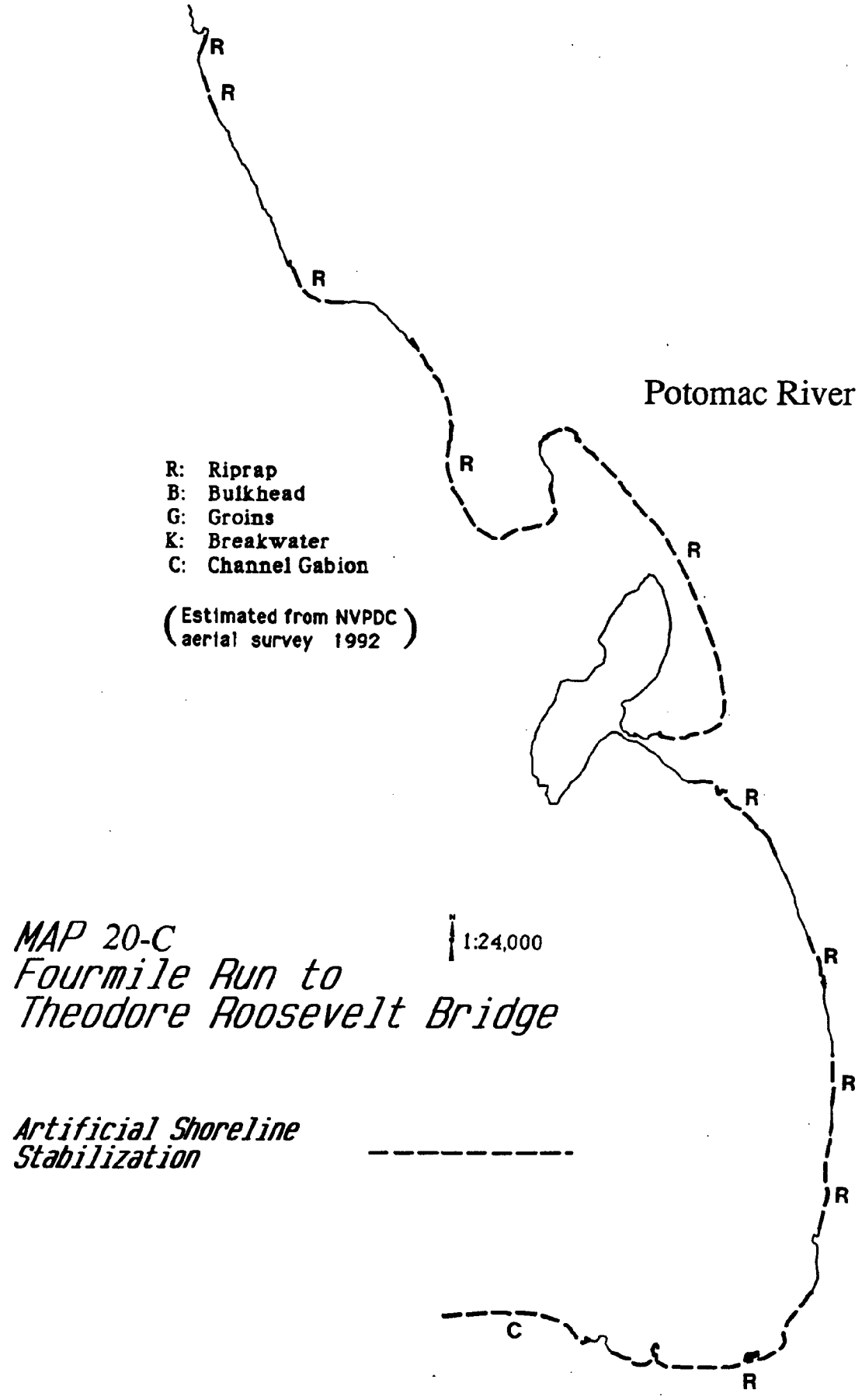
MAP 20-B
Fourmile Run to
Theodore Roosevelt Bridge

1971 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION

(Shoreline change map from digitized USGS quadrangles)

SIGNIFICANT EROSION *

Moderate:	**(<3ft./yr.)**	**M**
Severe:	**(>3ft./yr.)**	**S**
Extreme:	**(>15ft./yr/)**	**X**


R
R
R
R
R
R
R
R
R
C
R
Potomac River
R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion
(Estimated from NVPDC aerial survey 1992)
1:24,000
MAP 20-C
Fourmile Run to
Theodore Roosevelt Bridge
Artificial Shoreline
Stabilization

MAP 21

Shoreline Segment: Theodore Roosevelt Bridge to Little Falls

USGS Quadrangle: Washington West

County: Arlington

Property Maps: None (all Federal)

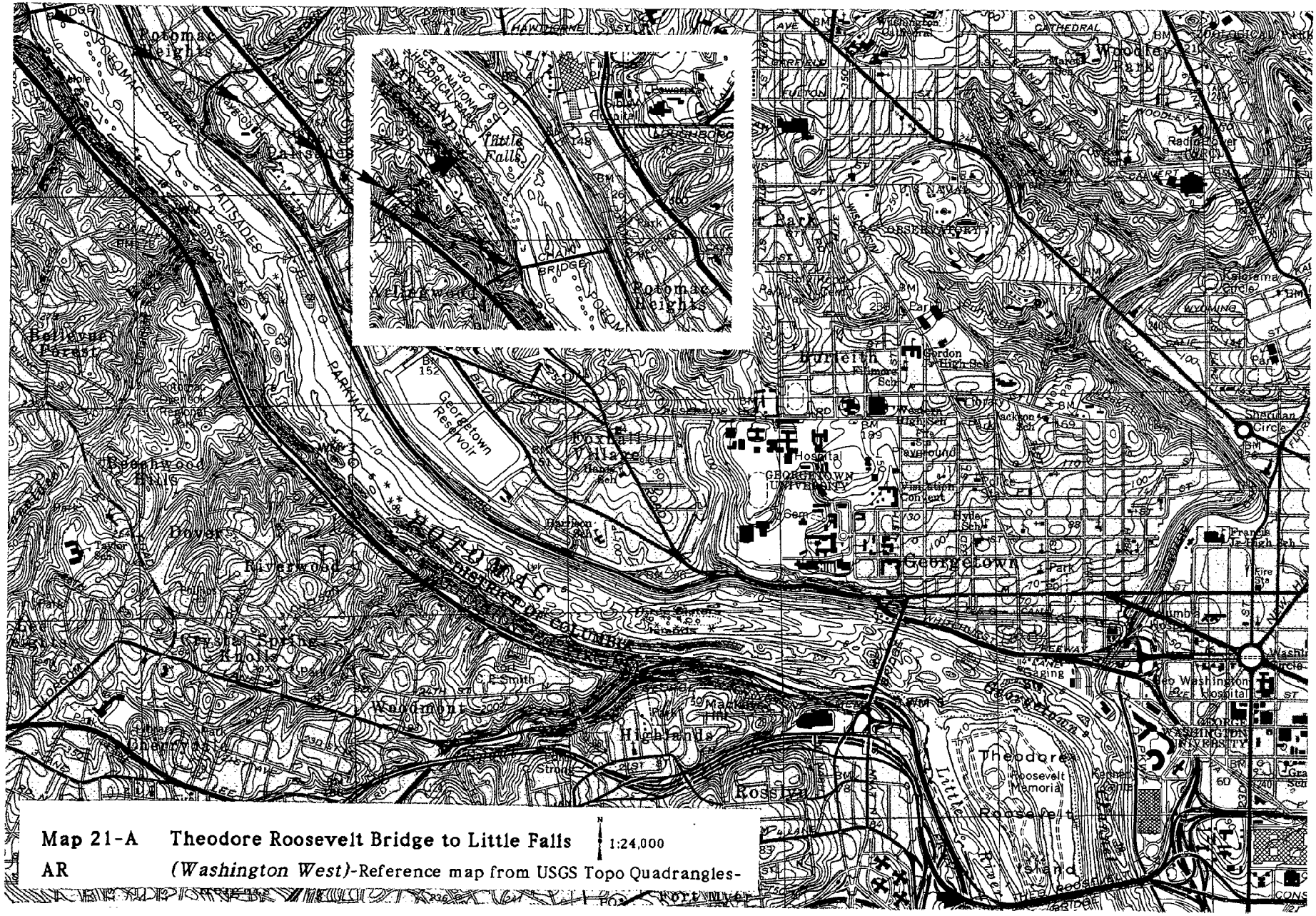
Water Body: Little River
Potomac River

Shoreline Description:
There are 5.0 miles of shoreline from Theodore Roosevelt Bridge to Little Falls. The first 0.6 mile is along Little River behind Theodore Roosevelt Island, and the remaining 4.4 miles of shoreline are along the Potomac River.

The shoreline is crossed by Theodore Roosevelt, Key and Chain Bridges. All of the shorelands in this segment are governmental. The George Washington Memorial Parkway runs along the entire shoreline to Chain Bridge.

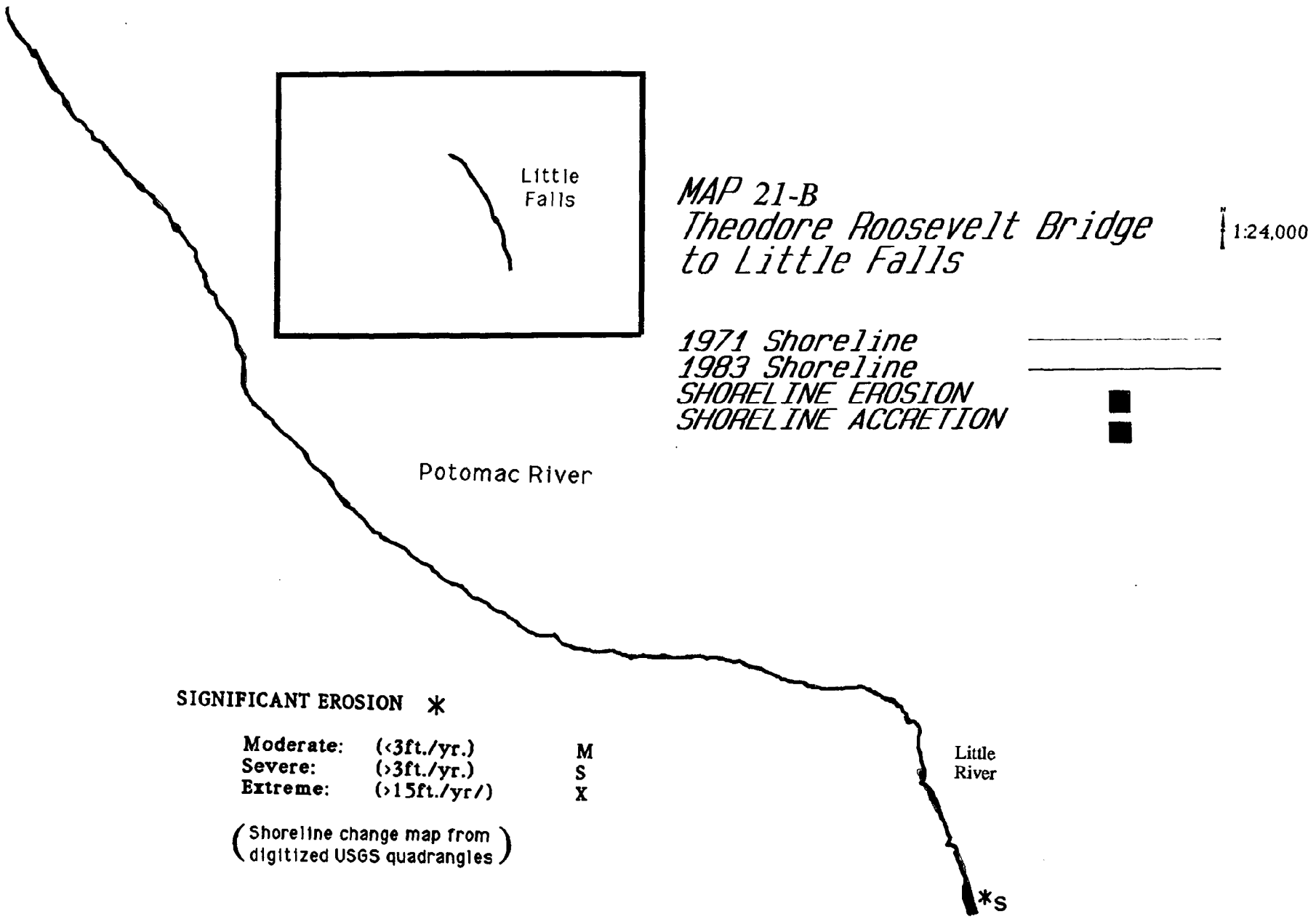
Erosion Situation:
The shoreline changes map shows that the area near the Theodore Roosevelt Bridge has experienced severe erosion (>3 ft/yr).

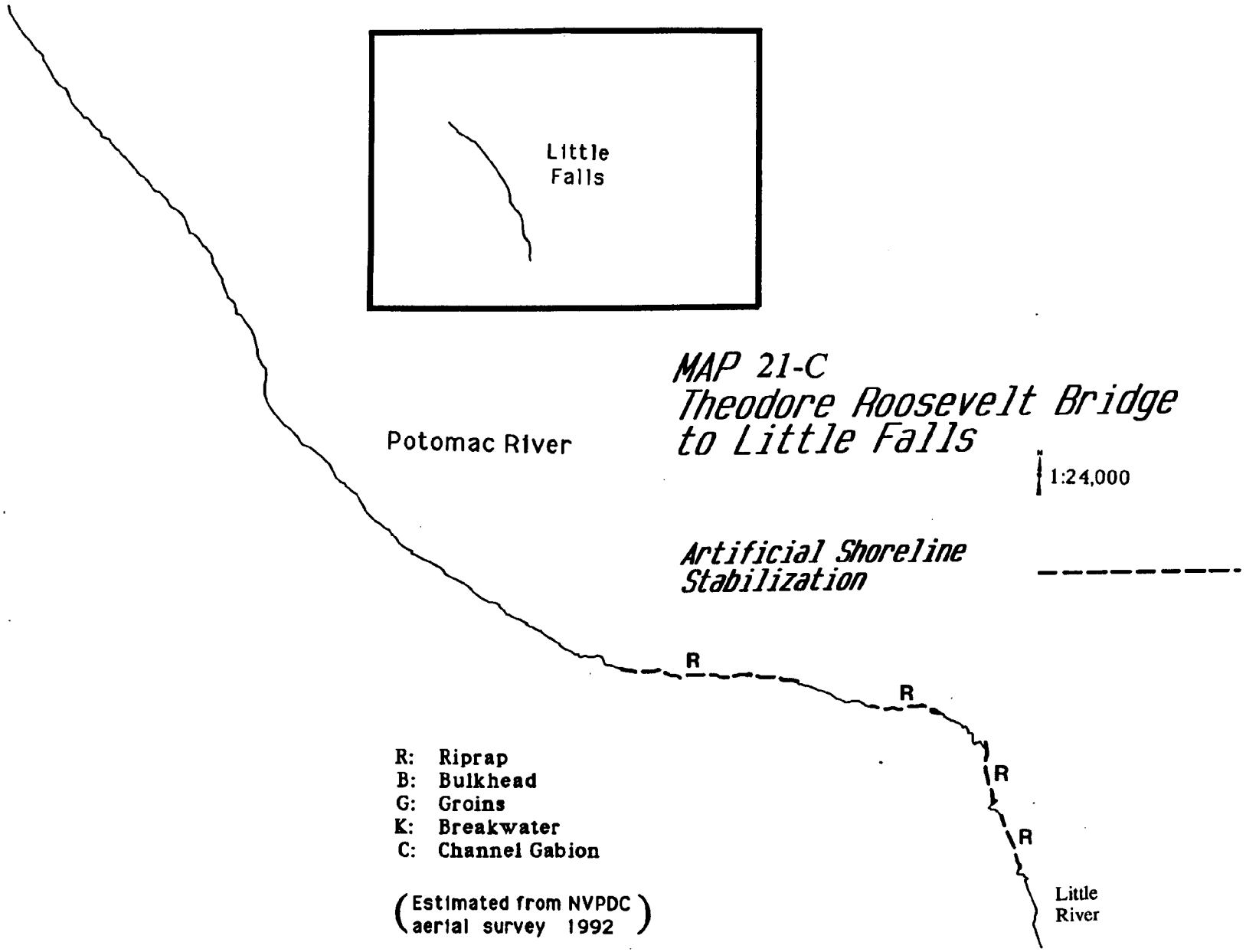
Artificial Stabilization:
There are 1.0 mile of riprap along 21% of the shoreline in this segment. The riprap is along the south end of the segment.



Map 21-A **Theodore Roosevelt Bridge to Little Falls** 1:24,000

AR *(Washington West)*-Reference map from USGS Topo Quadrangles-


Little
Falls
MAP 21-B
Theodore Roosevelt Bridge
to Little Falls
1:24,000
1971 Shoreline
1983 Shoreline
SHORELINE EROSION
SHORELINE ACCRETION
Potomac River
SIGNIFICANT EROSION *
Moderate: (<3ft./yr.) M
Severe: (>3ft./yr.) S
Extreme: (>15ft./yr/) X
(Shoreline change map from digitized USGS quadrangles)
Little
River
*S


Little
Falls
MAP 21-C
Theodore Roosevelt Bridge
to Little Falls
Potomac River
1:24,000
Artificial Shoreline
Stabilization
R
R
R
R
R
R: Riprap
B: Bulkhead
G: Groins
K: Breakwater
C: Channel Gabion
(Estimated from NVPDC
aerial survey 1992)
Little
River

Appendix 2

SHORELINE SITUATION REVIEW

The Shoreline Situation Reports (SSR) produced by the Virginia Institute of Marine Sciences (VIMS) for Prince William County (Rogers, *et. al.*, 1976), and for the Counties of Fairfax and Arlington, City of Alexandria (Owen, *et. al.*, 1979) covered 155.4 miles of tidal shoreline. The shoreline descriptions given in the report were for subsegment divisions which were based on changes in shoreline configuration, physical properties, or locality boundaries. The subsegments were identified in the SSR as follows:

Prince William County (PW),
Fairfax County (FX),
the City of Alexandria (AL), and
Arlington County (AR):

PW-5B: Chopawamsic Creek (2.7 mi.),
PW-5A: County Line to Shipping Point (3.6 mi.),
PW-4: Shipping Point to Possum Point (11.1 mi.),
PW-3B: Possum Point to Cockpit Point (2.5 mi.),
PW-3A: Cockpit Point to Freestone Point (6.8 mi.),
PW-2B: Freestone Point to Mouth of Neabsco Creek (9.8 mi.),
PW-2A: Mouth of Neabsco Creek to Deephole Point (14.8 mi.),
PW-1B: Deephole Point to I-95 Bridge (3.8 mi.),
PW-1A: I-95 Bridge to Occoquan River Dam (2.3 mi.),
FX-1: Occoquan River Dam to Sandy Point (10.9 mi.),
FX-2: Sandy Point to Hallowing Point (12.3 mi.),
FX-3A: Hallowing Point to Pohick Creek (8.7 mi.),
FX-3B: Pohick Creek to Whitestone Point (13.3 mi.),
FX-4A: Whitestone Point to Ferry Point (8.1 mi.),
FX-4B: Ferry Point to Sheridan Point (10.2 mi.),
FX-5: Sheridan Point to Hunting Creek (13.6 mi.),
AL-6: Hunting Creek to Fourmile Run (9.8 mi.), and
AR-7: Fourmile Run to Little Falls (11.1 mi.).

The shoreline characteristics which were described in the SSR include:

(1) Shorelands physiographic classification,
(2) Shorelands use classification,
(3) Shorelands ownership classification,
(4) Limitations to shore use and potential or alternative shore uses,
(5) Flood hazards level,
(6) Beach quality,
(7) Water quality, and
(8) Shore erosion situation.

(1) The **shorelands physiographic classification** included descriptions of:

- the fastlands: the zone landward of the shore,
- the shore: the zone of beaches and marshes, and
- the nearshore: the zone from the shore to MLW (the mean low water datum).

The *shoreline* was taken either as the fastland/shore boundary, or the shore/nearshore boundary. The measurements of shoreline length were given for each subsegment along the shore/nearshore boundary.

The *fastlands* were described by the average slope within 400 feet of the fastland/shore boundary. The classifications included:

- low shore: 20 feet or less of relief,
- moderately low shore: 20 - 40 feet of relief,
- moderately high shore: 40 - 60 feet of relief, and
- high shore: 60 feet or more of relief.

In addition, the presence or absence of bluffs along the fastland/shore boundary were noted.

The *shore zone* was defined as the buffer between the fastlands and the body of water. The landward limit of the shore zone was delineated by the line representing one and a half times the mean tide range above low water, and the seaward limit of the shore zone was given as the break in slope between the relatively steeper shoreface and the less steep nearshore zone. The SSR used the inner fringe of the marsh symbols on United States Geological Survey (USGS) topographic maps as the landward limit of the shore zone, and the mean high water line on the USGS topographic maps as the shoreline, or seaward limit of the shore zone.

The following categories were used to describe the shore zone:

- beach,
- fringe marsh,
- extensive marsh,
- embayed marsh, and
- artificially stabilized.

The distinctions between the various types of marshes were related to their size and potential functions. The SSR defined a *fringe marsh* as one that occurs in a band less than 400 feet in width and approximately parallel to the shore, and indicated that this type of marsh usually provides a buffer to wave erosion of the fastland. An *extensive marsh* was defined as a marsh that projects into the adjacent water body, and has extensive acreage. An

embayed marsh was defined as a marsh that occupies a re-entrant or drowned creek valley. The SSR indicated that in general an extensive marsh is likely to be a more efficient transporter of detritus and nutrients than an embayed marsh due to its greater drainage density.

In the SSR, the *nearshore zone* includes tidal flats, and extends from the shoreline which was taken as the mean low water line (MLW) to the 12-foot isobath. The nearshore zone was described as:

- Narrow: 12-foot isobath is < 400 yards from shore,
- Intermediate: 12-foot isobath is 400 - 1400 yards from shore, or
- Wide: 12-foot isobath is > 1400 yards from shore.

The shorelands physiographic classifications were graphically represented on the maps in the SSR, and were described in terms of the percent of the shoreline covered by the categories defined for the fastland, shore, and nearshore zones. The physiographic descriptions and data were derived from United States Geological Survey topographic maps and National Oceanic and Atmospheric Administration bathymetric charts. In addition, the Tidal Marsh Inventory reports produced by VIMS for Prince William County (1975), and Fairfax County (1976) were used. A summary spreadsheet of the shorelands physiographic data included in the SSR for Northern Virginia is included (Attachment 1A).

The physiographic descriptions of the fastlands and nearshore zones of the subsegments in Northern Virginia will not have significantly changed since the publication of the SSR. The shore zone designations will have changed, especially the amount of artificial stabilization. In addition, the marsh areas will have changed slightly since the publication of the SSR.

(2) The **shorelands use classification** was also separated into the primary uses of the fastland, shore, and nearshore zones. The following uses were included:

- Fastlands Zone:
  - Residential
  - Commercial
  - Industrial
  - Governmental
  - Recreational and Public Open Spaces
  - Preserved
  - Agricultural
  - Unmanaged:
    - Open, or
    - Wooded.

- Shore Zone:
  - Bathing
  - Boat Launching
  - Bird Watching
  - Waterfowl Hunting

- Nearshore Zone:
  - Pound Net Fishing
  - Shellfishing
  - Sport Fishing
  - Extraction of non-living Resources
  - Boating
  - Water Sports

(3) The **shorelands ownership classification** used in the SSR was divided into the following classes:

- Private, or
- Governmental:
  - Federal
  - State
  - County or City

The attached spreadsheets contain a summary of the shorelands use and ownership of the Northern Virginia segments as designated in the SSR (Attachment 1A). It is likely that changes have occurred in fastland use, especially regarding development, since the SSR were published in the 1970s.

The shore and nearshore uses, however, probably have not significantly changed. The shorelands ownership classification may or may not have undergone changes.

(4) The **limitations to shore use and potential or alternative shore uses** category in the SSR described specific factors which impose limits on the type or extent of shoreline development, as well as the potential for recreational uses of the shore zone. Both physical and political limitations were included; a subsegments topography, proximity to marshes, vulnerability to erosion, flooding potential, local development policy and zoning regulations, or current uses were defined as possible limits to potential or alternative shore uses.

The alternative shore uses category is useful for identifying the areas that may have undergone changes in use or ownership since the SSR were published. In addition this category is extremely useful for identifying new areas of potential beach access and public recreational activities.

Attachment 1B lists the *alternative shore uses* as given in the SSR. Some changes have occurred; *this category should updated at some point because of its inherent use to planners and shoreline managers in Northern Virginia.*

(5) The **flood hazards** level information in the Prince William County SSR were derived from United States Army Corps of Engineers reports; the reports indicated that the Intermediate Regional Flood (an average recurrence time of 100 years) has an average water level of 8 feet above the mean water level. Flood data for Fairfax and Arlington Counties were extracted from the Federal Insurance Administration "Flood Hazard Boundary Maps." The reports indicated that most of the flooding is due to heavy rains, extreme runoff, and swelling of the river. The maps indicated that the 100-year flood would range from 9.3 to 9.8 feet above MSL (mean sea level) in Fairfax County, and up to 21 feet above MSL for some portions of Arlington County. Flood data for Alexandria were extracted from the City of Alexandria's "Flood Plain Map, 1977" (Ordinance No. 2182). The map indicated that the 100-year flood would range from 12 to 15 feet above MSL.

The flood hazards section also indicated areas where structures are in danger of flooding. This section could be updated at some future point with revised flood level information and the reidentification of endangered structures. The *flood hazards* assessments from the SSR are included in Attachment 1C along with the *beach quality* and *water quality* assessments.

(6) The **beach quality** evaluation was based on the nature of the beach material, length and width of the beach, and the general aesthetic appeal of the beach setting. Most of the beaches were rated *poor* to *fair* because the beaches in Northern Virginia are mainly thin and usually vegetated. This category reflects a subjective judgment, and is unlikely to have significantly changed.

(7) The **water quality** evaluation category was included in the SSR for Fairfax and Arlington, City of Alexandria, but was not included for Prince William County. However, the text of the Prince William County report indicated that several creeks were experiencing water quality problems (in 1976), and that discharges into several creeks did not meet the State Water Control Board's Embayment Standards. For example, the SSR indicated that "Neabsco Creek is sterile due to a chlorine overdose several years ago."

The data for the water quality section were derived from the Virginia State Water Control Board's publications Water Quality Standard (November, 1974), and Water Quality Inventory (305 b) (April, 1976). According to the 1979 SSR, no area of the Upper Potomac River met the Virginia water quality standard all of the time. The Metropolitan Washington Council of Governments, March 1978, "208 Water Quality Plan" stated that "the capacity of the estuary to absorb waste loads is limited and is heavily dependent on Potomac flows to overcome tidal action which confines

wastes in the upper estuary." The data in this category are outdated and should not be used; the *water quality* evaluations should be revised.

(8) The **shore erosion situation** category contained the following information:

- Erosion rate,
- Endangered Structures, and
- Shore protective structures.

A review of the information contained in the SSR reveals that there was no data on erosion rates for any of the subsegments. However, the maps provided in the reports showed areas of moderate erosion (1 to 3 feet/year) in subsegments: FX-1: Occoquan River Dam to Sandy Point, FX-2: Sandy Point to Hallowing Point, FX-3A: Hallowing Point to Pohick Creek, FX-4A: Whitestone Point to Ferry Point, and FX-4B: Ferry Point to Sheridan Point. Additionally, the text described the erosion situation for each subsegment. Attachment 1D presents a summary of the text descriptions of the erosion situation for each of the segments as presented in the SSR.

The Summary of Shoreline Situation Reports for Virginia's Tidewater Localities (C. Hobbs, D. Owen, and L. Morgan, 1979) indicated that there were 27 separate SSR produced for the 34 counties and cities bordering approximately 5000 miles of Virginia's tidal waters. The erosion rate information in the SSR were, in part, obtained from a mid 1970s VIMS study that was published in 1977 as Shoreline Erosion in Tidewater Virginia, by Robert Byrne and Gary Anderson. The study established long term erosion rates by comparing the high water shoreline positions on maps from the 1850's and the 1940s. In addition, aerial photographs of the late 1930s and mid 1970s were used to assess more recent trends. However, the comparisons were not made for the Northern Virginia shorelines, and hence the "no data" for erosion rates in these SSR.

The evaluations of the erosion situation that are in the SSR were made from field investigations and interviews with local inhabitants. The reports indicated that both wave attack and downhill rain runoff contribute to the slight to moderate erosion occurring in some sections of the study area. However, the reports concluded, "Generally, erosion is not considered to be a significant problem for this area of the Potomac River. Populated shoreline areas have been largely artificially stabilized." The reports indicated that only one house on the northern end of Chopawamsic Island, and one house at the mouth of Gunston Cove were endangered by continuing erosion.

The SSR contained maps with areas of artificial stabilization and areas of moderate erosion represented by symbols. However, the quality of the graphics was poor, and not all of the areas described in the text as

experiencing slight erosion were depicted. The descriptions and extent of artificial shoreline stabilization structures were derived from oblique aerial photography. Attachment 1D contains a summary of the artificial shoreline stabilization structures. This information should be updated.

Attachment 2A-1

PHYSIOGRAPHIC DATA FOR NORTHERN VIRGINIA, 1976/1979

(Miles)

Subsegments	PW-5B	PW-5A	PW-4	PW-3B	PW-3A	PW-2B	PW-2A	PW-1B	PW-1A	FX-1	FX-2	FX-3A	FX-3B	FX-4A	FX-4B	FX-5	AL-6	AR-7
Shorelands Physiography																		
FASTLANDS																		
Artificial Fill	nd	nd	nd	nd	nd	nd	nd	nd	nd	0	0	0	0	0	0	1.7	1.3	0.2
Low Shore	1.5	0.6	1	0.3	2	1.2	7.7	1.9	0	5.5	0.5	2.6	9.5	4.2	3.7	3.6	7.1	4.8
Moderately Low Shore	0.6	2.7	6.1	0.4	1.7	1.2	0.2	0	1.4	8.9	8.4	2.9	2.4	2.1	4.8	1.9	1.4	2
Mod. Low Shore with Bluffs	0	0.1	0.3	0	0	0	0	0	0	0.5	3.1	1.4	0	0	0	0	0	0
Moderately High Shore	0.8	0	1.3	0.7	1.3	1.6	0	0.8	0.4	0.1	0	0.4	0.9	0.3	0	1.8	0	0.4
Mod. High Shore with Bluffs	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.2	0	0	0
High Shore	0.8	0	0.8	0.7	1.2	1.2	0	0.2	0.6	1.6	0	1	0.3	0.3	0.8	0.2	0	0.4
High Shore with Bluffs	0	0	0.3	0.6	0.4	0.3	0	0.2	0	0.5	0	1	0	1.1	0.5	0	0	3.2
SHORE																		
Artificially Stabilized	0	1.4	0.3	0.6	0.1	0.2	1.3	0.6	1.3	0.2	0.9	0.5	0.5	1.4	1.7	1.5	4	3
Beach	0	1.4	2.8	1.9	2.2	1.1	0.5	1.7	0.1	0.6	3.9	3.9	1.4	2.8	1.5	2.6	1.3	2.1
Fringe Marsh	1.2	0	2.7	0	1.9	2.3	1.1	0.3	0.9	6.3	0.6	2.9	9.8	2.5	3.6	3.2	4.4	5.9
Embayed Marsh	1.5	0.4	3.4	0.1	2.6	6.2	6.4	0.2	0	3.8	7	1.4	1.7	1.3	3.3	0	0.1	0
Extensive Marsh	0	0.4	1.9	0	0	0	5.5	1	0	0	0	0	0	0	0	6.3	0	0
NEARSHORE																		
Narrow	nd*	1	nd*	2.5	1.3	0	0	nd*	nd*	0	1.3	1.2	0	1.6	0.6	0.8	4.7	7.3
Intermediate	nd*	1.6	nd*	0	0	0	0	nd*	nd*	0	0.9	1.5	0	0	2.2	6.6	0.8	1.6
Wide	nd*	0	nd*	0	1.1	1.1	4	nd*	nd*	0	4.1	0	0	0	0	0	0	0
Shorelands Use																		
Agricultural	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.4	0	0.2	0	0	0	0	0	0
Commercial	0	0	0	0	0	0.6	0	0	0.5	0	0	0	0	0	0	0.2	0.4	0
Governmental	3.6	2.8	2.8	0	0	0	1.8	1.2	0	0	0	0	13.2	5.9	0	0	0.8	0.8
Industrial	0	0	2.3	0.9	1	0.2	0.4	0	0.4	1.8	0	0	0	0	0.2	0	4.2	3.6
Perserved	0	0	0	0	0	0	1.5	0	0	8.7	1.1	1.1	0	0	1.4	0.2	0	0
Recreational	0	0	0	0	0	0	0.5	0	0	0	8.7	3.8	0	0.3	2.1	5.4	3.2	6.1
Residential	0	0.5	1.1	0	0.5	0.2	1.2	0.6	1.1	1.8	1.8	2.2	0	1.5	5.9	2.9	0.6	0.4
Unmanaged, Open	0	0	0	0	0	0	0	0.2	0	0.1	0	0	0	0.3	0.3	0.2	0.5	0
Unmanaged, Wooded	0	0	3.4	1.8	5.2	4.4	2.5	1.1	0.3	4.4	0.5	2	0	0.2	0.2	0.3	0	0
Ownership																		
Private	0	0.5	6.9	2.7	6.7	4	4.1	1.9	2.3	7.1	2.3	5.6	0	2.2	7.7	4	2.2	0.9
Federal	3.6	2.8	2.8	0	0	0	3.3	1.2	0	0	0	0	13.2	5.9	2.1	5.2	6.9	8
State	nd	nd	nd	nd	nd	nd	nd	nd	nd	8.7	1.1	0	0	0	0	0	0	2.2
County/City	0	0	0	0	0	1.4	0.5	0	0	1.3	8.6	3.8	0	0	0.2	0	0.7	0
Total Miles																		
Fastland	3.6	3.4	9.6	2.7	6.7	5.4	7.9	3.1	2.3	17.1	12	9.3	13.2	8.1	10	9.2	9.8	11.1
Shoreline	2.7	3.6	11.1	2.5	6.8	9.8	14.8	3.8	2.3	10.9	12.3	8.7	13.3	8.1	10.2	13.6	9.8	11.1

nd = no data; not included in original report

nd* = nd data (too shallow to measure)

Attachment 2A-2

SUMMARY PHYSIOGRAPHIC DATA FOR NORTHERN VIRGINIA, 1976/1979

	Prince Wm. County	Fairfax County	City of Alexandria	Arlington County	
Shorelands Physiography	**(miles)**	**(miles)**	**(miles)**	**(miles)**	**(Total)**
FASTLANDS					
Artificial Fill	*nd	1.7	1.3	0.2	
Low Shore	16.2	29.6	7.1	4.8	57.7
Moderately Low Shore	14.3	31.4	1.4	2.0	49.1
Mod. Low Shore with Bluffs	0.4	5.0	0	0	5.4
Moderately High Shore	6.9	3.5	0	0.4	10.8
Mod. High Shore with Bluffs	0	0.3	0	0	0.3
High Shore	5.5	4.2	0	0.4	10.1
High Shore with Bluffs	1.8	3.1	0	3.2	8.1
SHORE					
Artificially Stabilized	5.8	6.7	4.0	3.0	19.5
Beach	11.7	16.7	1.3	2.1	31.8
Fringe Marsh	10.4	28.9	4.4	5.9	49.6
Embayed Marsh	20.8	18.5	0.1	0	39.4
Extensive Marsh	8.8	6.3			15.1
NEARSHORE					
Narrow	4.8	5.5	4.7	7.3	22.3
Intermediate	1.6	11.2	0.8	1.6	15.2
Wide	6.2	4.1	0	0	10.3
SHORELANDS USE					
Agricultural	*nd	0.6	0	0	0.6
Commercial	1.1	0.2	0.4	0	1.7
Governmental	12.2	19.1	0.8	0.8	32.9
Industrial	5.2	2.0	4.2	3.6	15.0
Perserved	1.5	12.5	0	0	14.0
Recreational	0.5	20.3	3.2	6.1	30.1
Residential	5.2	16.1	0.6	0.4	22.3
Unmanaged, Open	0.2	0.9	0.5	0	1.6
Unmanaged, Wooded	18.7	7.6	0	0	26.3
Ownership					
Private	29.1	28.9	2.2	0.9	61.1
Federal	13.7	26.4	6.9	8.0	55.0
State	*nd	9.8	0	2.2	12.0
County/City	1.9	13.9	0.7	0	16.5
Total Miles					
Fastland	44.7	78.9	9.8	11.1	144.5
Shoreline	57.4	77.1	9.8	11.1	155.4

*no data

Attachment 2B

NORTHERN VIRGINIA ALTERNATE SHORE USES, 1976/1979

The **limitations to shore use and potential or alternate shore uses** listed in the SSR are as follows (verbatim) (*note* - the italicized rating refers to potential for alternative uses):

PW-5B: Chopawamsic Creek. *None.* The present government ownership and use of this subsegment prohibits alternate development.

PW-5A: County Line to Shipping Point. *Low.* The present use and ownership of this subsegment precludes alternate development.

PW-4: Shipping Point to Possum Point. *Low.* The area near the town of Dumfries could be developed as a low intensity recreational park. Other alternate uses for this segment are limited due to existing use and ownership.

PW-3B: Possum Point to Cockpit Point. *Low.* For 66% of the shore lands which are presently unused, development depends upon access across the railroad tracks.

PW-3A: Cockpit Point to Freestone Point. *Low.* Two areas have development potential, although any construction should ensure against adding pollutants to the waters. A low intensity recreational park would be possible along the shore lands near Georgetown Village.

PW-2B: Freestone Point to Mouth of Neabsco Creek. *Low.* Although 54% of the shoreline is presently unused, development here would be costly because of the lack of access to the area.

PW-2A: Mouth of Neabsco Creek to Deephole Point. *Low.* This subsegment already has a county owned recreational park and a wildlife refuge along the shoreline. Little alternate use seems necessary for the unused, wooded lands located in this subsegment.

PW-1B: Deephole Point to I-95 Bridge. *Moderate.* The unmanaged, wooded area located in front of River Bend Estates has the possibility of becoming a low intensity recreational area.

PW-1A: I-95 Bridge to Occoquan River Dam. *Low.* The present use of the shoreline restricts alternate development.

FX-1: Occoquan River Dam to Sandy Point. *Moderate.* The 41% of the shore lands which are private are being developed for residential purposes.

FX-2: Sandy Point to Hallowing Point. *Low.* Given that 81% of the shore lands are owned by the state and local governments, there are few private lands available for development.

FX-3A: Hallowing Point to Pohick Creek. *Low.* The 40% of the shore lands which are privately owned are already largely developed. Some continued residential development is possible in some areas of the shoreline.

FX-3B: Pohick Creek to Whitestone Point. *Low.* No private development is possible unless the government relinquishes control of the area.

FX-4A: Whitestone Point to Ferry Point. *Moderate.* The unused areas of the subsegment are located near residential sections. These areas will probably be developed for residences also.

FX-4B: Ferry Point to Sheridan Point. *Low.* Most of the private lands have already been developed for residential purposes.

FX-5: Sheridan Point to Hunting Creek. *Low.* Most of the segment is either preserved or is already consumed. There are few privately owned and unused lands.

AL-6: Hunting Creek to Four Mile Run. *High.* The City of Alexandria plans to revitalize its waterfront for recreational open space, small businesses, and commercial shipping. However, any development of the Alexandria waterfront depends upon the outcome of the shore ownership dispute between the city and the federal government.

AR-7: Four Mile Run to Little Falls. *Low.* All shore lands are being used. Any new use would be via redevelopment of existing areas.

Attachment 2C

NORTHERN VIRGINIA
FLOOD HAZARD, WATER QUALITY, AND BEACH QUALITY, 1976/1979

Subsegment	Flood Hazard	Water Quality	Beach Quality
PW-5B	Low	not listed	No Beaches
PW-5A	Low	not listed	Poor
PW-4	Low	not listed	Poor
PW-3B	Low	not listed	Poor to Fair
PW-3A	Low	not listed	Fair to Good
PW-2B	Low	not listed	Poor to Good
PW-2A	Low to Moderate	not listed	Poor
PW-1B	Low to Moderate	not listed	Fair to Poor
PW-1A	Low	not listed	Poor
FX-1	Moderate to High	Good	Poor
FX-2	Moderate	Good	Fair
FX-3A	Moderate	Good	Fair
FX-3B	Moderate	Good	Fair
FX-4A	Moderate	Good	Fair
FX-4B	Moderate	Good	Fair
FX-5	Moderate to High	Poor to Fair	Fair
AL-6	High	Poor to Fair	Poor
AR-7	Low to Moderate	Poor to Fair	Poor

Attachment 2D

NORTHERN VIRGINIA SHORELINE EROSION SITUATION, 1976/1979

The Shoreline Situation Reports produced by the Virginia Institute of Marine Sciences (VIMS) for Prince William County (1976), and for the Counties of Fairfax and Arlington, City of Alexandria (1979) indicated that the **shoreline erosion situation** of the mid 1970s was as follows:

PW-5B: Chopawamsic Creek.
The shoreline does not appear to be eroding. There are no structures along the shore.

PW-5A: Prince William county line to Shipping Point.
The majority of the shoreline is stable with the exception of 0.1 mile of bluffed shoreline on Chopawamsic Island which is experiencing moderate erosion due mainly to downhill rain runoff and wind and wave actions at the base of the cliff. The house at the northern end of Chopawamsic Island is endangered by erosion. There are approximately 7,600 feet of artificial stabilization, the majority of which is at the Quantico boat dock. There are two large piers at the boat dock with several boat slips. The stabilization at the southern end of Chopawamsic Island is totally ineffective.

PW-4: Shipping Point to Possum Point.
Most of the area appears to be stable; however, there is some bluff erosion due to downhill rain runoff. There are 1,800 feet of bulkhead in a residential area that appears to be effective.

PW-3B: Possum Point to Cockpit Point.
The bluff areas north of the power plant are eroding due to rain runoff and undercutting of the cliff base from wind and wave actions. There are approximately 3,000 feet of effective riprap and bulkheads near Possum Point in front of the substation, appears effective.

PW-3A: Cockpit Point to Freestone Point.
The area **appears to be stable**, with no endangered structures. There is 1 groin, which appears to be effective. There are also a fishing pier and boat house on the beach.

PW-2B: Freestone Point to the northern side of the mouth of Neabsco Creek.
The bluffs at Freestone Point are experiencing **minor erosion** due to runoff and undercutting by wind and wave action. There are approximately 1,200 feet of mainly cosmetic artificial stabilization on the south bank of the creek at the

marina facilities, in addition to several boat ramps and numerous piers. There are about 50 feet of effective riprap to the east of the railroad bridge.

PW-2A: The northern side of the mouth of Neabsco Creek to Deephole Point.
Although the shoreline **appears to be stable,** there are 7,300 feet of artificial stabilization. Approximately 3,600 feet of riprap from the mouth of Marumsco Creek to Deephole Point appear to effectively protect the road that is close to the shore in that area. Bayside Park and Featherstone Shores have approximately 3,400 feet of bulkhead and several groins along the shore, all of which appears to be effective. There are numerous piers along the shoreline and docking facilities and a boat ramp at the marina just north of Featherstone Shores, with about 300 feet of bulkheading that is mainly used for commercial purposes.

PW-1B: Deephole Point to the I-95 Bridge.
The area **appears to be stable.** Along the shoreline of the Military Reservation there are approximately 2,000 feet of riprap, which appears to be effective. Northwest of the Route 1 bridge there are around 800 feet of effective bulkhead which appears to be mainly cosmetic as erosion is not a significant problem here.

PW1A: The I-95 Bridge to the Occoquan River.
Although the shoreline **appears stable,** it has 6800' of effective bulkheading located at the commercial and industrial areas and along most of the shoreline near Occoquan.

FX-1: The Occoquan River Dam to Sandy Point.
Downhill rain runoff causes some erosion along sections of the Belmont Bay shoreline. There are approximately 650 feet of bulkhead just east of the railroad bridge, 50 feet of bulkhead near the mouth of Massey Creek, and 100 feet of riprap in the residential section of Massey Creek. There are also several piers. The structures appear to be effective and were mainly erected for cosmetic and commercial purposes.

FX-2: Sandy Point and Hallowing Point.
This area is experiencing moderate bluff erosion (1 to 3 feet/year) from Sycamore Point to Sandy Point due from both rain runoff erosion and wave attack of the shore. There are several piers in this segment and approximately 4,500 feet of bulkhead along the Hallowing Point River Estates shoreline. Several areas south of Sandy Point have riprap along the shoreline, and there are three groins south of the riprapped areas The shoreline stabilization structures are for the most part, effective, however, there are gaps between structures in residential areas that reduce the overall effectiveness.

FX-3A: Hallowing Point to Pohick Creek.
This segment is undergoing moderate erosion (1 to 3 feet/year) from Hallowing Point to the inside of Gunston Cove, which is due mainly to downhill rain runoff rather than wave attack of the shoreline. One house at the mouth of Gunston

Cove is endangered by the erosion situation. There are 2,500 feet of artificial stabilization which appears to be effective. There are several groins north of Hallowing Point; the remaining structures are mainly bulkheads and some riprap. There are also several piers and a boat ramp in this segment.

FX-3B: Pohick Creek to Whitestone Point.
There is no significant erosion in this segment. The 2,500 feet of bulkhead and riprap appear to be more for cosmetic purposes rather than for shoreline stabilization. There are many docks and several boat ramps at the mouth of Gunston Cove.

FX-4A: Whitestone Point to Ferry Point.
The bluffs near Whitestone Point are experiencing moderate erosion (1 to 3 feet/year) due to downhill rain runoff and wave action undercutting the base of the cliffs. The 7,600 feet of bulkhead and riprap appears to be effective elsewhere in the segment. There are numerous piers and docks located from the Mount Vernon Yacht Club to Ferry Point.

FX-4B: Ferry Point to Sheridan Point.
The bluffs north of Ferry Point are experiencing moderate erosion (1 to 3 feet/year), and much of the remainder of the segment has been artificially stabilized with approximately 9,200 feet of bulkhead and riprap. There is a pier at Mount Vernon.

FX-5: Sheridan Point to Hunting Creek.
There is no significant erosion along this segment; however, there are approximately 8,100 feet of apparently effective bulkhead and riprap. There is also a marina with several piers and docks.

AL-6: Hunting Creek to Four Mile Run.
This segment is experiencing little or no erosion. There are approximately 21,000 feet of artificially stabilized shoreline. Some of the bulkheading is old and is in need of strengthening or replacement. The Alexandria Waterfront has numerous piers and docks

AR-7: Four Mile Run to Little Falls.
There is little or no erosion in the Arlington segment. There are approximately 15,900 feet of artificially stabilized shoreline which is mainly effective riprap. There are also several boat ramps and piers in this segment.

Appendix 3

NORTHERN VIRGINIA
SHORELINE EROSION MAILING LIST

Arlington County
Environmental Services Division
No. 1 Courthouse Plaza
2100 Clarendon Boulevard
Arlington, VA 22201

City of Alexandria
Transportation and Environmental Services
P.O. Box 178
City Hall
Alexandria, VA 22313

Commonwealth of Virginia Marine Resources Commission
2600 Washington Avenue
P.O. Box 756
Newport News, VA 23607-0756

Council on the Environment
Coastal and Oceans Program
Environmental Program Analyst
903 9th Street Office Building
Richmond, VA 23219

Fairfax County
Fairfax County Wetlands Board
c/o Office of Comprehensive Planning
4050 Legato Road, Suite 800
Fairfax, VA 22033

Featherstone & Mason Neck National Wildlife Refuges
Mason Neck NWR
14416 Jefferson Davis Highway, Suite 20A
Woodbridge, VA 22191

George Washington Memorial Parkway
National Park Service
c/o Turkey Run Park
McLean, VA 22101

Interstate Chesapeake Bay Commission (EPA)
60 West Street, Suite 200
Annapolis, MD 21401

Interstate Commission on the Potomac River Basin
6110 Executive Boulevard, Suite 300
Rockville, MD 20852-3903

Mason Neck State Park & Leesylvania State Park
Virginia Department of Conservation and Recreation
Division of State Parks
203 Gouvenor Street, Suite 306
Richmond, VA 23219

Military Development in the National Capital Region
PM NCR
Building 257, Stop 388
Ft. Belvoir, VA 22060-5388

National Airport
Engineering Division, Environmental Section
Metropolitan Washington Airport Society
National Airport
Washington, DC 20001

Prince William County
Wetlands Board of Prince William County
c/o Department of Public Works, Watershed Management
4361 Ridgewood Center Drive
Prince William, VA 22191-5308

Regional Parks
Northern Virginia Regional Park Authority
5400 Ox Road
Fairfax Station, VA 22039

State Water Control Board (SWCB)
P.O. Box 11143
Richmond, VA 22230

U.S. Army Corps of Engineers
Northern Virginia Regional Office
Plaza South, Suite 102
138 Graham Park Road
Dumfries, VA 22026

U.S. Army, Ft. Belvoir
Environmental and National Resources
DEH-ENZ
Building 1442
Ft. Belvoir, VA 22060-5113

U.S. Marine Corps, Quantico
Public Works Branch, MCCDC, CO42
P.O. Box 1855
Quantico, VA 22134-0855

Virginia Department of Conservation and Recreation
Shoreline Erosion Advisory Service (SEAS)
P.O. Box 1024
Gloucester Point, VA 23062

Virginia Department of Game and Inland Fisheries
4010 West Broad Street
Richmond, VA 23230

Virginia Institute of Marine Sciences (VIMS)
P.O. Box 1346
Gloucester Point, VA 23062

Appendix 4

SUMMARY OF NEW AND POTENTIAL SHORELINE EROSION INFORMATION SOURCES IN NORTHERN VIRGINIA

The following report summarizes the information obtained and the literature reviewed to date.

(1) Virginia Institute of Marine Sciences (VIMS)

VIMS is developing The Comprehensive Coastal Inventory for the Virginia coastline to support shoreline management programs. It is intended to be mainly a collation effort with an aim of acquiring all existing data sets and providing a common format for the data. It is intended to complement ongoing data collection efforts such as the Tidal Rivers Inventory Project.

Base scale for The Comprehensive Coastal Inventory is 1:24,000 with "critical areas" at a scale of 1:5,000. The system is designed to include rates of erosion and accretion, shoreline mobility, nearshore profiles and bathymetry, sediment characteristics, sediment budget, wind and wave characteristics, distribution and performance of engineering structures, identification of non-living and living marine resources, land use, level of development and valuation, and land ownership and claims.

The system was proposed in 1988 and is scheduled to be completed over a five year period and then updated in five year cycles. At the current time (3/92), the system is not complete, and contains no data for Northern Virginia.

The Shoreline Situation Reports are being used as the background material for the Comprehensive Coastal Inventory; they are updating them as they enter the data. They have not done anything with the report on Prince William County, nor the Counties of Fairfax, Arlington, City of Alexandria report.

VIMS' Tidal Rivers Inventory Project has completed mainly rural counties; however, the completion for Northern Virginia is unlikely because of a lack of funds. As far as priorities go, the Upper Potomac is low on the list because there are very few "critical areas" in terms of erosion and species habitat.

VIMS has flown aerial reconnaissance of Virginia's coast up to Westmoreland County. They are using their vertical aerial photos, and some Highway Department photos for digitizing new shoreline positions.

They are using oblique low altitude aerial video coverage for the delineation of erosion control structures.

The Tidal Rivers Inventory Project is mainly concerned with the ecology of the rivers. The oyster grounds have been mapped at 1:5,000, and everything else at 1:24,000. They have mapped submerged aquatic vegetation through the Northern Neck. They are currently transferring the hard copy Tidal Marsh Inventories done in the 70's and 80's for each coastal county in Virginia to a digital form.

(2) Council on the Environment

The work being done at VIMS will be incorporated into the EcoMAPS geographic information system at Council on the Environment. The Council is also working with Fish and Wildlife on producing new National Wetlands Inventory maps. The Northern Virginia area has not been done yet.

EcoMAPS does not contain any high resolution shoreline boundary files for the Potomac. It does include the 1:100,000 digital line graphs, but the shoreline is very blocky. The Council is looking into getting a better boundary file.

(3) United States Geological Survey (USGS), and National Oceanic and Atmospheric Administration

(A) Shorelines on Maps and Charts

The most common sources for coastal geographic information are the USGS 1:24,000 topographic maps (quadrangles) and the NOAA 1:40,000 bathymetric charts. These maps and charts are easy to obtain and are inexpensive. The following seven quadrangles cover the Northern Virginia shoreline:

- Alexandria (1983)
- Fort Belvoir (1983)
- Indian Head (1982)
- Mount Vernon (1983)
- Occoquan (1984)
- Quantico (1983) and
- Washington West (1983)

Two NOAA charts cover the area:

- 12288: Potomac River, Lower Cedar Point to Mattawoman Creek (16th edition, June 30, 1990), and

- 12289: Potomac River, Mattawoman Creek to Georgetown (44th edition, January 27, 1990).

USGS updates their maps about once a decade, and NOAA updates their charts about every two years. The date on a map or chart, however, does not reflect the date of the shoreline information. The USGS is mainly concerned with topography and NOAA is mainly concerned with bathymetry, and therefore the map and chart revisions do not contain shoreline revisions unless the differences are blatantly obvious on aerial photographs.

Prior to the 1960s the Army Corps of Engineers printed all shoreline quadrangles. In the early 1960s, the responsibility was transferred to USGS. In the mid 1970s, NOAA provided USGS with shoreline and bathymetric data. The current series of quadrangles contain shorelines provided by NOAA.

There are two methods for producing NOAA charts: Photogrammetric and Hydrographic. The Photogrammetry division uses aerial photographs to delineate the shoreline. The Hydrography division goes into the field and produces Hydrographic surveys; they do soundings for bathymetry and use traditional survey methods to map the shoreline. The Hydrography people field check the charts produced by the Photogrammetric people, but their major interest is bathymetry, not shoreline positions.

The best data on shorelines comes from the T-sheets, or topographic surveys, that NOAA does in coastal areas. There are a set of T-sheets from the mid to late 1800s, a set from the 1930s to 1950s, and a set from the early 1970s for the Potomac River. The survey data is collated and then registered as the accepted shoreline. The shorelines on the USGS maps and on the NOAA charts are all from the last "registered" shoreline. The shoreline surveys were done at 1:10,000 from 1971 to 1974 and the shoreline was registered in 1977. ALL UPPER POTOMAC SHORELINES CURRENTLY BEING USED ON NOAA CHARTS AND USGS MAPS WERE DERIVED FROM THE 1971 TO 1974 SURVEYS EVEN THOUGH THE DATES ON THE MAPS OR CHARTS ARE 1980s AND 1990s.

In the late 1970s NOAA digitized the mean high water line of the Upper Potomac. These digital files are available, but cost ~$500 per chart, and were done on the 26th datum (the 27th datum is the one currently in use). The Chief of External Affairs is the person to talk to about obtaining the shoreline files.

NOAA is currently working with Intergraph on producing a new set of digital shorelines including both the mean high water and mean low water lines. The NOAA project manager, Richard Hogan of Nautical Charting at

(301) 443-8061, said that they will not be able to release these files for about a year because the shorelines have not yet been verified.

(B) Historic Charts

The National Archives Cartographic Depository on Pickett Street in Alexandria, Virginia, has many historic charts for the Potomac River. NVPDC obtained copies of the following charts (note: #560 is now #12289, and #559 is now #12288):

#560, Edition 10	September, 1910
#560, Edition 23	September, 1953; Revised May, 1957
#560, Edition 33	February, 1973
#559, Edition 1	July, 1907
#559, Edition 4	July, 1935; Revised February, 1956
#559, Edition 10	March, 1973

(C) Potomac Shoreline Study

The United States Geological Survey published a Water-Supply Paper in 1987 by Andrew Miller called Shore Erosion as a Sediment Source to the Tidal Potomac River, Maryland and Virginia; A Water-Quality Study of the Tidal Potomac River and Estuary. The study area extends from Gunston Cove to the mouth of the Potomac, and therefore includes Prince William county and the southern portion of Fairfax County. The paper includes an excellent write-up on the causes of erosion, the methods of measuring erosion rates, and the accuracy of measurements of shoreline change.

The average erosion rate determined from cartographic and photographic methods for the stretch of coast from Gunston Cove to Chopawamsic Creek range from 0.1 to 0.5 m/yr. However, selected points along Mason Neck were determined to have recession rates as high as 2.0 m/yr.

August 10, 1992

Addresses of Owners Who Need to Be Contacted by SEAS

Parcel Number(s)

1. FX102-2 1-20 The American Horticultural Society
Mt. Vernon, VA 22121
(lot address: 7931 E. Boulevard Drive, Alexandria, VA 22308)

2. 110-3 13-16 Oxford Partnership
8808-H Pear Tree Court
Alexandria, VA 22309
(lot address: 9514 Lynnhall Place, Alexandria, VA 22309)

3. 110-3 13-17 Taylor Burke
9515 Lynnhall Place
Alexandria, VA 22309

4. 110-3 13-18A Irene Kabler
9513 Lynnhall Place
Alexandria, VA 22309

5. 110-4 6-11C Mehrangiz Khanrzadeh
9521 Ferry Harbor Court
Alexandria, VA 22309

6. 110-4 6-11D Ronald Balazik
9517 Ferry Harbor Court
Alexandria, VA 22309

7. 110-4 9-2-4 Melisende C. Bart
3100 Brandywine Street, NW
Washington, DC 20008
(lot address: 4007 Belle River Terrace, Alexandria, VA 22309)

8. 111-1 21-29 Richard O. Keys
3213 Woodland Lane
Alexandria, VA 22309
(lot address: 3209 Woodland Lane, Alexandria, VA 22309)

9. 111-1 21-30 Richard O. Keys
3213 Woodland Lane
Alexandria, VA 22309

10. 111-1 21-28 Mary Elizabeth Brahm
3201 Woodland Lane
Alexandria, VA 22309
(lot address: 3205 Woodland Lane, Alexandria, VA 22309)

11. 111-1 15-4A James H. Baker
9006 Captain's Row
Alexandria, VA 22308

12. 111-1 15-5A Wilhelmus Verhoeren
9004 Captain's Row
Alexandria, VA 22308

13. 111-1 15-6A Courtney J. Suter, Jr.
9002 Captain's Row
Alexandria, VA 22308

14. 111-1 15-7A James Ray Cottrell
9000 Captain's Row
Alexandria, VA 22308

15. 111-1 15-8A Resident
1860 Ala Moana Boulevard, Apt. 1704
Honolulu, HW 96815

16. 111-1 15-9A Edward Jedrziewski
8912 Captain's Row
Alexandria, VA 22308

17. 111-1 15-10A Robert Watts
8910 Captain's Row
Alexandria, VA 22308

18. 111-1 6-17-7A Robert J. Evans
8616 Thomas J. Stockton Parkway
Alexandria, VA 22308

19. 111-1 6-17-8A William F. Beyer
8613 Thomas J. Stockton Parkway
Alexandria, VA 22308

20. 114-3 1-11 Woodrow Wilson Boy Scout Reservation

21. 114-4 1-11 Lester Stribling
6590 Pohick Bay Drive
Lorton, VA 22079
(lot address: 6600 Pohick Bay Drive, Lorton, VA 22079)

22. 114-4 1-14 Margaret Tomlinson
2836 Rangewood Terrace
Atlanta, GA 30345
(lot address: 10647 Gunston Road, Lorton, VA 22079)

23. 114-4 1-15 Margaret Tomlinson
2836 Rangewood Terrace
Atlanta, GA 30345
(lot address: 10649 Gunston Road, Lorton, VA 22079)

24. 117-2 1-7 John H. Arial, Jr.
10814 Belmont Blvd.
Lorton, VA 22079

25. 117-2 1-8 Samuel W. Rothberg
8021 E. Boulevard Drive
Alexandria, VA 22308
(lot address: 10816 Belmont Blvd., Lorton, VA 22079)

26. 117-2 1-14 Elias No-uhra
10606 Belmont Blvd.
Lorton, VA 22079

27. 117-2 1-24 Belmont Bay Farms, Ltd.
1707 Duke Street
Alexandria, VA 22314

28. 118-1 2-47 Robert L. Ware
6 Meander
Chatham, IL 62629
(lot address: 7421 Belmont Landing Road, Lorton, VA 22079)

29. 118-1 2-48 Marshall L. Ware
1600 Westbrook Avenue
Richmond, VA 23227
(lot address: 7425 Belmont Land Road, Lorton, VA 22079)

30. 118-1 2-A James A. Foster
7454 Belmont Landing Road
Lorton, VA 22079

31. 118-1 2-94 Anne W. Rinavdot
4176 S. 36th Street
Arlington, VA 22206
(lot address: 7607 Bayview Drive, Lorton, VA 22079)

32. 118-1 2-93 Roger M. Twist
202 E. Iris Avenue
Lantana, FL 33462
(lot address: 7611 Bayview Drive, Lorton, VA 22079)

33. 118-1 2-92 Anne W. Rinavdot
4176 S. 36th Street
Arlington, VA 22206
(lot address: 7615 Bayview Drive, Lorton, VA 22079)

34. 118-1 2-91 Anne W. Rinavdot
4176 S. 36th Street
Arlington, VA 22206
(lot address: 7619 Bayview Drive, Lorton, VA 22079)

35. 118-1 1-5 First Fac Inc.
c/o Murray J. Belman, Suite 100
1120 Vermont Avenue, NW
Washington, DC 20005

36. 118-1 1-4 Leonard Wixson
3304 Dauphine Drive
Falls Church, VA 22042
(lot address: 10806 Belmont Blvd., Lorton, VA 22079)

37. 119-1 1-1 Commonwealth of Virginia
Gunston Hall
9th Street Office Building
Richmond, VA 23219
(lot address: 10709 Gunston Road, Lorton, VA 22079)

38. 119-1 3-3-7A Eugene Wills
6711 Lee Highway, Suite 4
Arlington, VA 22205
(lot address: 11189 Gunston Road, Lorton, VA 22079)

39. 119-1 3-7-13 Eugene Wills
Suite 4, 6711 Lee Highway
Arlington, VA 22205
(lot address: 11191 Gunston Road, Lorton, VA 22079)
(11209 thru 11021 Gunston Road (12 parcels), Lorton, VA 22079)

40. 119-4 1-1 Michael A. Willner
8519 Electric Avenue
Vienna, VA 22182
(lot address: 11521 Potomac Road, Lorton, VA 22079)

41. 119-4 1-1B John F. Murphy
5750 Hallowing Drive
Lorton, VA 22079

42. 119-4 1-1A Ted B. Kuemmerling
5700 Hallowing Drive
Lorton, VA 22079

43. 119-4 2-13-1 Gunston Manor Property Owner's Association, Inc.
5973 Foxglove Trail
Lorton, VA 22079
(property along River & Potomac Road)

44. 122-1 3-4 Arthur M. Reynolds
6013 River Drive
Lorton, VA 22079

45. 122-1 3-5 Judson O. Harrison
6017 River Drive
Lorton, VA 22079

46. 122-1 3-6 Tazewell F. Rufty
6021 River Drive
Lorton, VA 22079

47. 122-2 2-8 George E. Monroe
11801 River Drive
Lorton, VA 22079

48. 122-2 2-9 Peter D. Jarvis
11805 River Drive
Lorton, VA 22079

49. 122-2 2-38 Long Enterprises, Inc.
8253 Backlick Road
Lorton, VA 22079
(lot address: 5945 River Drive, Lorton, VA 22079)

50. 122-2 2-39 Hallowing Point Associates, Inc.
P.O. Box 63
Lorton, VA 22079
(lot address: 5949 River Drive, Lorton, VA 22079)

51. 122-2 3-2 Wallace R. Watson
5201 Queensbury Avenue
Springfield, VA 22151
(lot address: 6005 River Drive, Lorton, VA 22079)

52. 122-2 3-3 Richard F. Kennedy
6009 River Drive
Lorton, VA 22079

53. PW57 1-41A G. J. Manderfield
1098 Swan Point Road
Woodbridge, VA 22191

54. PW57 10-5-1 John J. Williams
1100 Swan Point Road
Woodbridge, VA 22191

55. PW42 1-8 Belmont Bay Limited Partnership
3251 Old Lee Highway, Suite 201
Fairfax, VA 22030
(lot address: 13901 Dawson Beach Road, Occoquan, VA 22125)

56. PW20 1-21A United States of America
P.O. Box 1830
Manassas, VA 22110
(lot address: 16001 Featherstone Road)

57. PW14 1-26 Dept. of Conservation & Economic Development
1201 Washington Building
Capital Square
Richmond, VA 23219
(lot address: 16501 Neabsco Road, Woodbridge, VA 22191)

58. PW9 1-39B Cockpit Point Limited Partnership
3000 K Street, NW, Suite 200
Washington, DC 20007
(lot address: 1500 Cherry Hill Road, Dumfries, VA 22026)

59. PW9 1-1 VMS/Arden Southbridge Venture
P.O. Box 723427
Atlanta, GA 30339
(lot address: 17375 Apple Lane)

Addresses of Owners Who Need to Be Contacted by SEAS

August 10, 1992

American Horticultural Society
Mt. Vernon, VA 22121

Ronald Balazik
9517 Ferry Harbor Court
Alexandria, VA 22309

Courtney J. Suter, Jr.
9002 Captain's Row
Alexandria, VA 22308

Oxford Partnership
8808-H Pear Tree Court
Alexandria, VA 22309

Melisende C. Bart
3100 Brandywine Street, NW
Washington, DC 20008

James Ray Cottrell
9000 Captain's Row
Alexandria, VA 22308

Taylor Burke
9515 Lynnhall Place
Alexandria, VA 22309

Richard O. Keys
3213 Woodland Lane
Alexandria, VA 22309

Resident
1860 Ala Moana Blvd., #1704
Honolulu, HW 96815

Irene Kabler
9513 Lynnhall Place
Alexandria, VA 22309

Mary Elizabeth Brahm
3201 Woodland Lane
Alexandria, VA 22309

Edward Jedrziewski
8912 Captain's Row
Alexandria, VA 22308

Mehrangiz Khanrzadeh
9521 Ferry Harbor Court
Alexandria, VA 22309

James H. Baker
9006 Captain's Row
Alexandria, VA 22308

Robert Watts
8910 Captain's Row
Alexandria, VA 22308

Wilhelmus Verhoeren
9004 Captain's Row
Alexandria, VA 22308

Robert J. Evans
8616 Thomas J. Stockton Pkwy.
Alexandria, VA 22308

William F. Beyer
8613 Thomas J. Stockton Pkwy.
Alexandria, VA 22308

Elias No-uhra
10606 Belmont Blvd.
Lorton, VA 22079

Roger M. Twist
202 E. Iris Avenue
Lantana, FL 33462

Woodrow Wilson Boy Scout
Reservation

Belmont Bay Farms, Ltd.
1707 Duke Street
Alexandria, VA 22314

First Fac Inc.
c/o Murray J. Belman, Suite 100
1120 Vermont Avenue, NW
Washington, DC 20005

Lester Stribling
6590 Pohick Bay Drive
Lorton, VA 22079

Robert L. Ware
6 Meander
Chatham, IL 62629

Leonard Wixson
3304 Dauphine Drive
Falls Church, VA 22042

Margaret Tomlinson
2836 Rangewood Terrace
Atlanta, GA 30345

Marshall L. Ware
1600 Westbrook Avenue
Richmond, VA 23227

Commonwealth of Virginia
Gunston Hall
9th Street Office Building
Richmond, VA 23219

John H. Arial, Jr.
10814 Belmont Blvd.
Lorton, VA 22079

James A. Foster
7454 Belmont Landing Road
Lorton, VA 22079

Eugene Wills
6711 Lee Highway, Suite 4
Arlington, VA 22205

Samuel W. Rothberg
8021 E. Boulevard Drive
Alexandria, VA 22308

Anne W. Rinavdot
4176 S. 36th Street
Arlington, VA 22206

Michael A. Willner
8519 Electric Avenue
Vienna, VA 22182

John F. Murphy
5750 Hallowing Drive
Lorton, VA 22079

George E. Monroe
11801 River Drive
Lorton, VA 22079

G. J. Manderfield
1098 Swan Point Road
Woodbridge, VA 22191

Ted B. Kuemmerling
5700 Hallowing Drive
Lorton, VA 22079

Peter D. Jarvis
11805 River Drive
Lorton, VA 22079

John J. Williams
1100 Swan Point Road
Woodbridge, VA 22191

Gunston Manor Property
Owner's Association, Inc.
5973 Foxglove Trail
Lorton, VA 22079

Long Enterprises, Inc.
8253 Backlick Road
Lorton, VA 22079

Belmont Bay Limited Partnership
3251 Old Lee Highway, Suite 201
Fairfax, VA 22030

Arthur M. Reynolds
6013 River Drive
Lorton, VA 22079

Hallowing Point Associates, Inc.
P.O. Box 63
Lorton, VA 22079

United States of America
P.O. Box 1830
Manassas, VA 22110

Judson O. Harrison
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Lorton, VA 22079

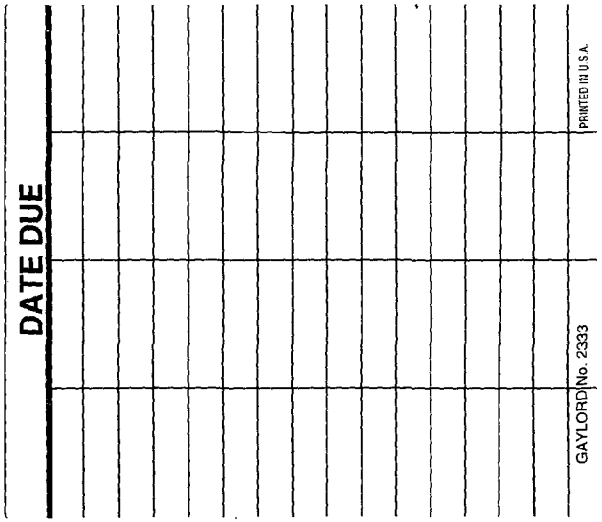
Wallace R. Watson
5201 Queensbury Avenue
Springfield, VA 22151

Dept. of Conservation &
Economic Development
1201 Washington Building
Capital Square
Richmond, VA 23219

Tazewell F. Rufty
6021 River Drive
Lorton, VA 22079

Richard F. Kennedy
6009 River Drive
Lorton, VA 22079

Cockpit Point Ltd. Partnership
3000 K Street, NW, Suite 200
Washington, DC 20007

VMS/Arden Southbridge Venture
P.O. Box 723427
Atlanta, GA 30339

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