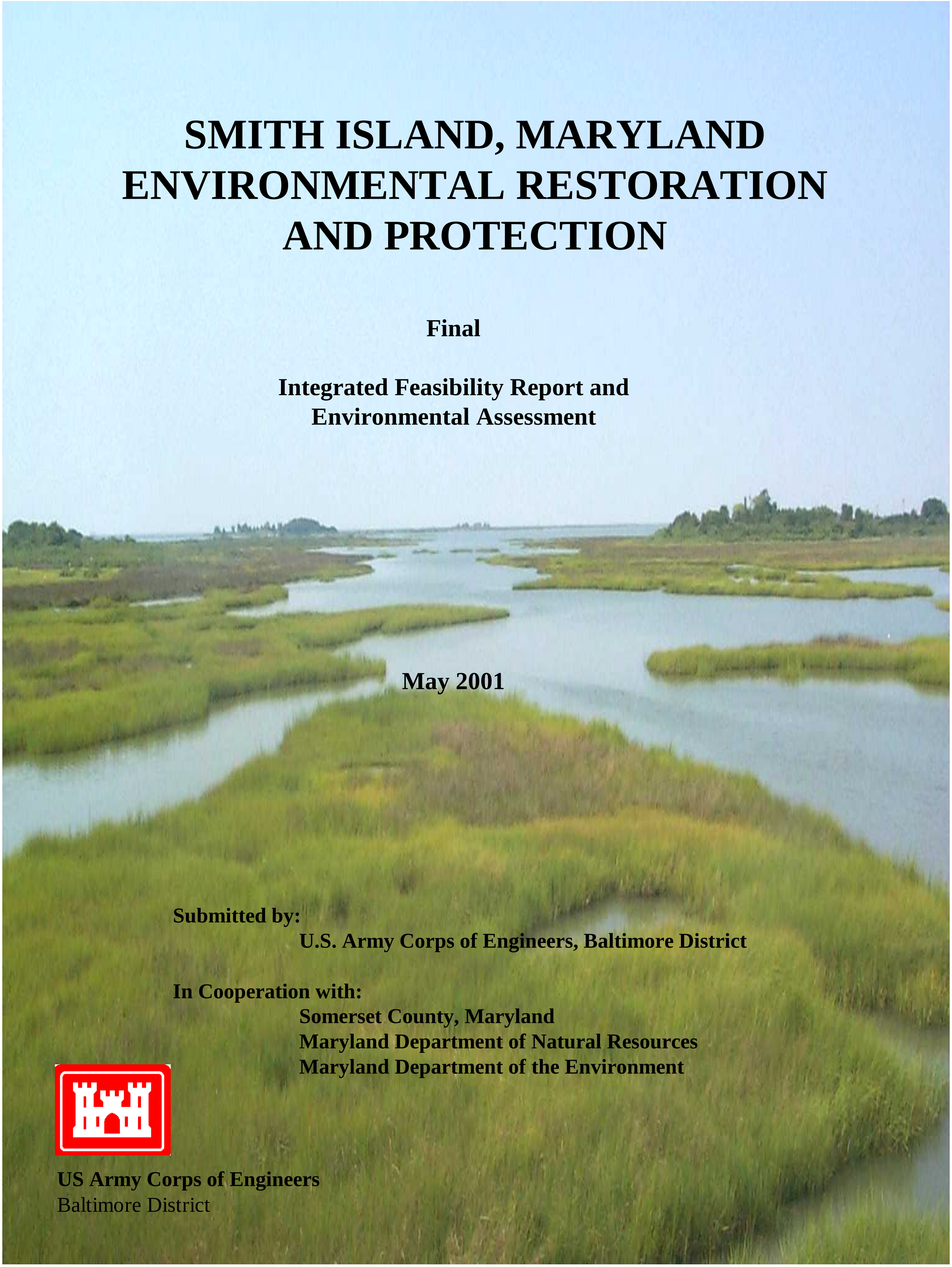

SMITH ISLAND, MARYLAND ENVIRONMENTAL RESTORATION AND PROTECTION

Final

Integrated Feasibility Report and Environmental Assessment

May 2001

Submitted by:

U.S. Army Corps of Engineers, Baltimore District

In Cooperation with:

Somerset County, Maryland
Maryland Department of Natural Resources
Maryland Department of the Environment

US Army Corps of Engineers
Baltimore District

Smith Island, Maryland
Environmental Restoration and Protection

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FINDING OF NO SIGNIFICANT IMPACT

SMITH ISLAND RESTORATION AND PROTECTION PROJECT

The Baltimore District, U.S. Army Corps of Engineers proposes a restoration and protection project off-shore of Martin National Wildlife Refuge, located on Smith Island, Maryland. The Corps proposes to construct a series of off-shore breakwaters, approximately 30 feet to 100 feet channel-ward of the existing shoreline along the western shoreline of Martin National Wildlife Refuge, and along Fog Point Cove and Back Cove. The action is in response to severe erosion and will restore a measure of geologic integrity to the island, thereby reducing aquatic habitat loss and the risk of damage to the island. The proposed project will protect and restore 1900 acres of submerged aquatic vegetation (SAV) and 215.7 acres of emergent marsh. In addition, backfill will be placed and planted with 23.5 acres of wetland vegetation to insure structural stability and increase the environmental benefits. The project is being undertaken in partnership with Maryland Department of Natural Resources (MdDNR) as the non-federal sponsor. The U.S. Army Corps of Engineers has worked in close partnership with MdDNR, Somerset County, Maryland Department of the Environment, the US Fish and Wildlife Service, and the National Marine Fisheries Service to ensure that the natural resources are protected.

The study was authorized by resolution of the House of Representatives on September 28, 1994, which provides authority for the Secretary of the Army to examine improvements on Smith Island, in the interest of navigation, flood control, erosion control, environmental restoration, wetlands protection, and other purposes. An Integrated Feasibility Study and Environmental Assessment (EA) has been prepared that evaluates various project alternatives and the potential costs and impacts associated with the proposed project. Potential impacts were assessed with regard to the physical, chemical, and biological characteristics of the aquatic and terrestrial ecosystem, endangered and threatened species, hazardous and toxic materials, aesthetics and recreation, cultural resources, and the general needs and welfare of the public. The EA concludes that there will be no significant adverse environmental impacts from this project. Instead, there are expected to be beneficial impacts to the environment, through the protection of SAV, emergent marsh, and erosion control. A review of the project concludes that this project complies with the Clean Water Act's Section 404(b)(1) guidelines for discharge of fill material. A water quality certificate is expected to be issued by the State of Maryland once designs are final and borrow site(s) are selected.

The enclosed EA was released for a thirty-day public review in March 2001. Upon reviewing the EA and Feasibility Report, comments, and responses to the enclosed comments, I find that there are no significant impacts associated with this project. The project has incorporated measures, such as design techniques, construction timing, methodologies, and monitoring to avoid and minimize impacts. The project will stabilize over 19,000 linear feet of the Smith Island shoreline, preventing further loss of SAV and emergent marsh. In order to protect the natural resources of Smith Island, the Baltimore District will continue agency coordination throughout the natural resources of Smith Island, the Baltimore District will continue agency coordination throughout the construction phase, follow environmental windows and use best-management practices to minimize temporary and minor construction impacts on SAV, nesting bird colonies, and the local economy. Borrow areas will be selected during construction phase, in full consultation with the resource agencies. In light of this finding of no significant impacts, no Environmental Impact Statement is required.

Gregory E. Stinner
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

Executive Summary

In a resolution of the Committee on Public Works and Transportation of the United States House of Representatives, adopted on September 28, 1994, the US Army Corps of Engineers was requested to conduct an investigation of Smith Island, Somerset County, Maryland:

> *Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Chesapeake Bay, Maryland and Virginia, published as House Document 176, Eighty-eighth Congress, First Session, and other reports pertinent to determine whether modifications of the recommendations contained therein are advisable at the present time, with particular emphasis on providing improvements on Smith Island, Maryland and Virginia, in the interest of navigation, flood control, erosion control, environmental restoration, wetlands protection, and other purposes.*

A reconnaissance report was completed in May 1997 that identified a Federal interest in several recommended plans on the island. One plan involved protection of the shoreline along the Town of Tylerton. Another plan involved navigation improvements to Sheep Pen Gut, near the Town of Rhodes Point. The other plans that were recommended in the reconnaissance phase involved the protection and restoration of submerged aquatic vegetation (SAV), shallow-water habitat and emergent marshland along the Martin National Wildlife Refuge in the northern half of the Island. The environmental restoration plans were selected based on the likelihood of success and the large habitat benefits of implementation. In May 1998, the Maryland Departments of Natural Resources and the Environment along with Somerset County entered into a legal agreement with the Baltimore District, Corps of Engineers, to proceed with a cost-shared feasibility study to address the recommendations of the reconnaissance phase. The goal of the study was to maximize environmental benefit to Smith Island, which is a critical component of the Chesapeake Bay ecosystem, and to implement a project to benefit the unique culture of watermen who live on the Island. The feasibility study was to formulate and recommend plans to benefit the project areas as defined in the reconnaissance report, although the final project was not necessarily to be limited to only those sites.

The Tylerton shoreline erosion and the Rhodes Point Navigation plans are not addressed fully in this report. They have been removed from the larger Smith Island Environmental Restoration and Protection Study and are being considered for implementation under other Corps authorities. The remaining plans are related in type and anticipated benefit. Each of the four plans within the recommended project is in the interest of environmental restoration.

Smith Island is part of a chain of islands that form the border between Chesapeake Bay and Tangier Sound, and is comprised of 97-percent emergent wetlands. The study area is within the largest contiguous SAV bed in the Bay. Although SAV coverages have been rebounding in the last decade throughout the Bay, the Tangier Sound area has seen continual decreases in coverage. As discussed in this report, there are many factors that determine whether or not SAV flourishes, some factors are local and some are larger-scale. SAV experts have determined that the likely over-riding factor in the study area is the effect of erosion. As the landmasses that make up Smith Island erode, it allows increased wave and current action into shallow-water areas that were previously protected, quiescent, and suitable for SAV growth. The eroded material also adds turbidity and nutrients to the water column that further inhibit SAV colonization and growth. Additionally, the landmasses themselves are extremely high quality emergent wetlands. These wetlands are even more valuable than most since they are part of a remote island with little human disruption. In its entirety, Smith Island has lost over 3,300 acres of wetlands in the last 150 years, and, in the identified project areas alone, it lost almost 2,400 acres of SAV between 1992 and 1998.

Investigations during this study involved understanding and quantifying the impact of the ongoing process of erosion on habitat degradation. It was determined that the tremendous loss of SAV around parts of Smith Island could be stopped and, to an extent, reversed by protecting and restoring lost wetlands in the Martin National Wildlife Refuge. The study team concluded that the most cost-effective and reliable way to accomplish this was to construct offshore, segmented breakwaters to protect or recreate strategic areas along the coastline of the Refuge. In many areas, the breakwaters would be back-filled using borrow material from the Bay bottom west of the Island. This back-fill would create additional wetland habitat and greatly increase the effectiveness of the structures. Many alternative plans were identified and evaluated, and the most cost-effective ones with the greatest benefits and lowest impacts were selected to be in the recommended project. Four main areas of analysis were identified in the reconnaissance effort and were carried through the feasibility process, the Western Shoreline, Fog Point Cove, Back Cove and Terrapin Sand Cove. Each of these areas has been seriously degraded over time due to erosion. Of the four, no plan at Terrapin Sand Cove was recommended for implementation due to the exorbitant cost. Plans at the other three areas that form the recommended project are estimated to protect 216 acres of wetlands and 504 acres of SAV over a 50-year life span, while at the same time creating 24 acres of wetlands and 1,440 acres of SAV habitat over the same time. Minimal adverse impacts are anticipated as a result of construction including temporary and localized turbidity and impacts related to offshore borrow sites, if utilized. The project will require 68,000 cubic yards of material for back-fill and will cost a baseline estimated $7.4 million to implement in November 2000 dollars. The non-Federal sponsor(s) will be responsible for $2.6 million and the Federal government will be responsible for $4.8 million of the total cost. The fully-funded cost estimate is $8.9 million and is shown in Section 7. This cost would be shared $5.8 million Federal and $3.1 million non-Federal.

The Western Shoreline project component consists of 9,400 feet of protected shoreline along Martin National Wildlife Refuge. Much of this land is a quickly eroding peninsula that protects a large body of water known as Big Thorofare. The peninsula has breached in several areas and large SAV beds that are now exposed to sedimentation and wave action are disappearing rapidly. The historical SAV beds of almost 2,000 acres have shrunk to less than 250 acres. Estimates made during the feasibility study concluded that this plan would prevent the loss of 135 acres of wetlands over the 50-year project life and would reclaim 1,200 acres of SAV habitat.

Fog Point Cove, Back Cove and Terrapin Sand Cove are large, protected areas of shallow water along the outer shoreline of the Refuge. These coves were all historically protected by peninsulas or spits of land and provided ideal conditions for SAV and other valuable habitats. These coves are now in various stages of degradation; however, they still are productive or potentially productive. Terrapin Sand Cove, the most degraded of the three, was dropped from further consideration due to the cost of restoration, over $18 million for the base plan. The two plans recommended for Fog Point and Back Coves will protect or reestablish the protective landmasses using breakwaters as discussed for the Western Shoreline project. Between the two project components, there will be an estimated 265 acres of SAV protected and 231 more acres created. Also, there will be 80.5 acres of wetlands protected, and 15.8 acres of wetlands created using backfill from an offshore borrow site.

Although the Martin National Wildlife Refuge is Federally owned land, it must be noted that the primary objective of this study, and the majority of the benefits to be derived from the recommended project, involves the protection and restoration of SAV habitat. Projects could have been developed to protect the SAV habitat areas and not the Federally owned landmass, but that would have entailed much more expensive construction methods and would not have addressed the primary local culprit of the SAV decline. That is, without protecting and stabilizing the eroding land, the SAV beds will continue to experience sedimentation and turbidity that blocks the life supporting sun light. There are two factors that create turbidity and choke off the light supply to the SAV plants, suspended solids in the water column and excess nutrients that create algae blooms in the water column. Both factors are direct impacts of local erosion of wetlands.

In summary, the results of this feasibility study show that there is a project in the Federal interest that can be implemented to produce extensive environmental benefits with only temporary and minor adverse impacts to the construction areas in perhaps the ecologically most important area of Chesapeake Bay. The non-Federal sponsors, the Maryland Departments of Natural Resources and the Environment and Somerset County, are in agreement with the findings of this report and have indicated their intent to provide the non-Federal cooperation required for project implementation, as indicated in the letter of _____, 2000. A draft Finding of No Significant Impact (FONSI) and a Section 404(b)(1) evaluation are including in this document. In view of this expression of non-Federal support and the favorable results of the technical analyses, the District Engineer recommends that the improvements described in Section 5 of this report be authorized for construction.

Smith Island Environmental Restoration and Protection, Maryland

Draft Feasibility Report and Integrated Environmental Assessment

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Section 1

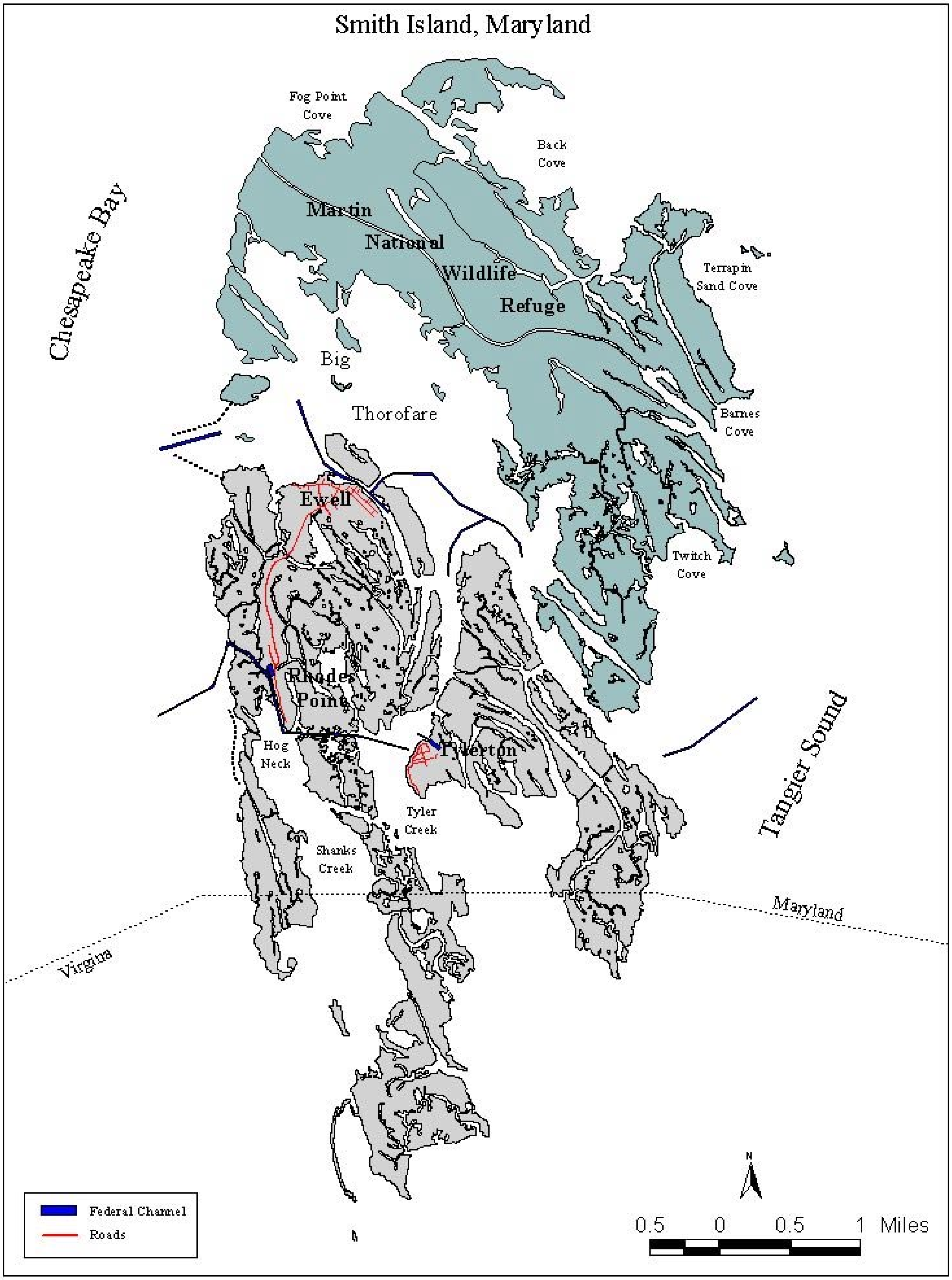
INTRODUCTION

This document is a product of the Smith Island Environmental Restoration and Protection, Maryland, Feasibility Study, and was initiated by the U.S. Army Corps of Engineers (USACE) in June 1998 in partnership with Somerset County and the State of Maryland. The reconnaissance report, dated May 1997, documented the results of preliminary evaluations of various plans for environmental restoration, navigation improvement, and erosion protection projects for Smith Island. Tasks during the feasibility study included establishing existing conditions, collecting and analyzing environmental and engineering data, and formulating and evaluating environmental restoration plans. This report includes recommendations for plans for environmental restoration at Smith Island, and also serves as the National Environmental Policy Act (NEPA) documentation for the proposed projects by including an integrated environmental assessment (EA). This report also documents the implementation of an erosion control project for the town of Tylerton, Smith Island, under the authority of Section 510 of the Water Resources Development Act (WRDA) of 1996, but does not act as the EA or decision document for Tylerton. The Rhodes Point navigation plan, as recommended in the reconnaissance report, has been considered in a separate document under the authority of Section 107 of the River and Harbor Act of 1960, as amended.

1.1 PURPOSE

Smith Island is an ecologically significant cluster of marshy landmasses separated by tidally influenced guts and open water. Over the past 150 years, the island has lost over 30-percent of its area to erosion. Smith Island is within a chain of islands that form the western boundary of Tangier Sound, and is within the area of highest submerged aquatic vegetation (SAV) concentration in Chesapeake Bay. The island itself is approximately 97-percent wetlands. These wetlands provide valuable habitat for a range of wildlife, and this value is enhanced by the protection offered by virtue of being on a remote island. There are three populated towns on Smith Island with a total population of less than 380. The northern half of the Island comprises that Martin National Wildlife Refuge and is undisturbed by direct human influence (Figure 1.1). With the high rate of erosion, 8 to 12 feet per year in some areas, continuing to threaten and destroy valuable habitat and impact the residents of the Island, the reconnaissance report made many recommendations for consideration during the feasibility study. The purposes of this report are to respond to the 1994 Congressional Resolution that tasked the Corps to identify problems or problem areas, to present the evaluation of potential solutions that will enhance the water resources of the region, and to identify plans to recommend for implementation.

Figure 1.1: Location map - Smith Island, showing Martin National Wildlife Refuge



1.2 STUDY AUTHORITY

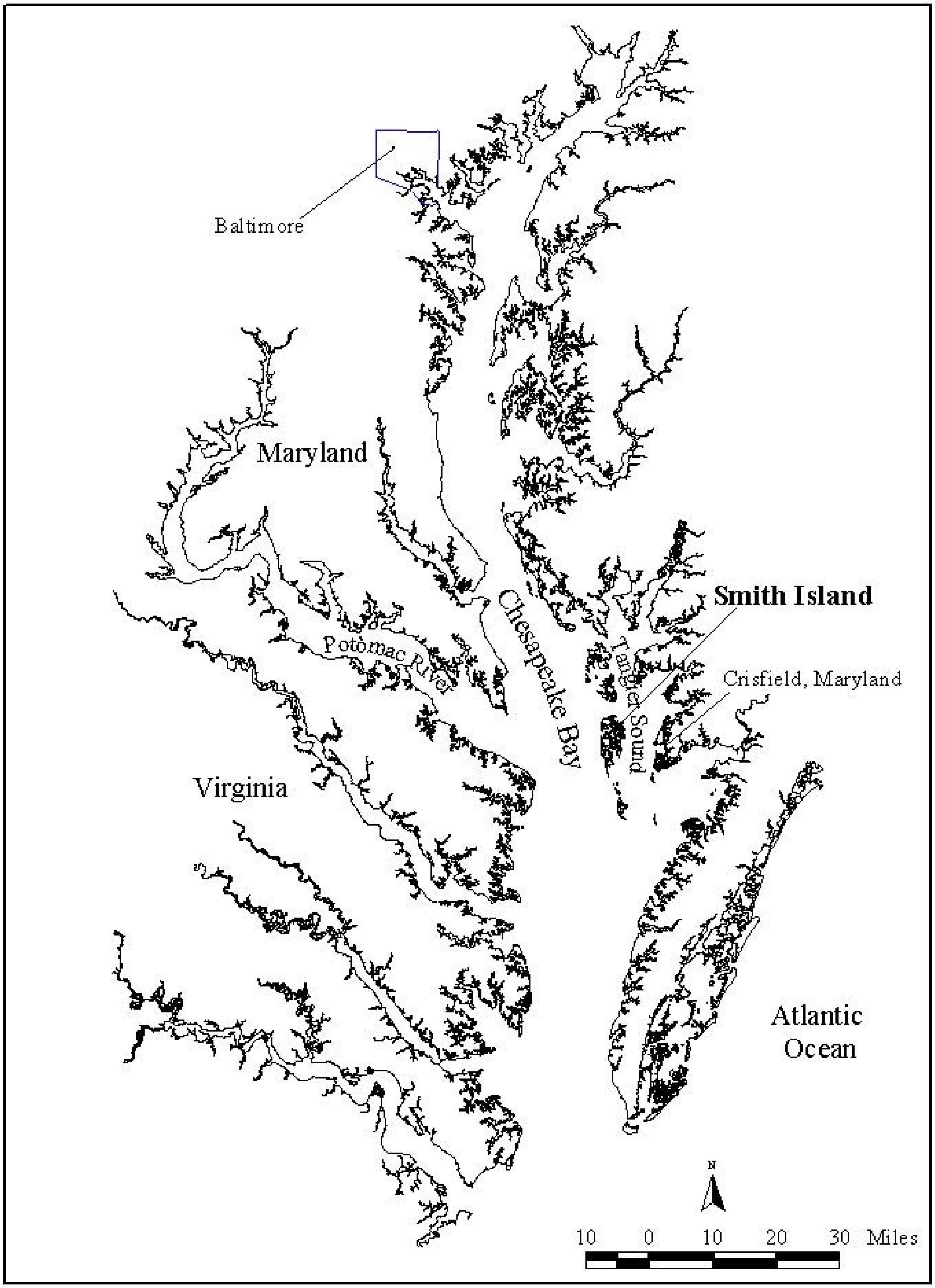
The Smith Island Environmental Restoration and Protection, Maryland, study was authorized by a resolution of the House of Representatives on September 28, 1994. The resolution was sponsored by Representative Wayne T. Gilchrest, MD-1, and states:

> *Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Chesapeake Bay, Maryland and Virginia, published as House Document 176, Eighty-eighth Congress, First Session, and other reports pertinent to determine whether modifications of the recommendations contained therein are advisable at the present time, with particular emphasis on providing improvements on Smith Island, Maryland and Virginia, in the interest of navigation, flood control, erosion control, environmental restoration, wetlands protection, and other purposes.*

1.3 STUDY AREA

Smith Island is situated 12 miles west of Crisfield, Maryland, and 95 miles south of Baltimore, Maryland (Figure 1.2). Smith Island is bounded to the east by Tangier Sound and the west by Chesapeake Bay. The island is approximately 8,000 acres in area and is 8 miles long by 4 miles wide. The island is actually many islands separated by guts (tidally influenced creeks or channels). Smith Island lies mostly in Somerset County, Maryland, although the southern tip lies in Accomack County, Virginia. All three of the island's population centers are in Maryland. Since the non-Federal sponsors are Somerset County and the State of Maryland, the feasibility study area was reduced to include only the Maryland portion of the island and the surrounding waters. The Maryland portion of Smith Island, shown in Figure 1.2, comprises approximately 7,000 acres of land and contains the three populated towns and Martin National Wildlife Refuge. The southernmost portion of Hog Neck and two other unnamed peninsulas are located in Virginia, total approximately 1,000 acres, and were removed from the study area for the purposes of this report.

Figure 1.2: Location of Smith Island, Maryland



1.4 SCOPE OF STUDY

This report documents current environmental and habitat conditions in the Maryland portion of Smith Island, an analysis of potential improvements in the study area, and a summary of future conditions with and without restoration. This report also considers plans for the towns of Tylerton and Rhodes Point, which were favorable recommendations of the reconnaissance phase. This report contains some technical and policy information that was utilized to implement the Tylerton recommendation under Section 510 and to complete the Rhodes Point study under Section 107. The evaluations of the alternatives and recommendations are based on site-specific technical information and exhaustive literature research obtained since the completion of the reconnaissance report in 1997. This information includes recent surveys and new mapping (post-1997), environmental habitat and geotechnical evaluations, economic studies, SAV research, and hydraulic modeling and evaluations. The various investigations and analyses were conducted at a feasibility-level of detail.

The scope of the feasibility study is relatively detailed in the various plans of analysis, problem identification, analysis of alternatives and inputs, and development and evaluation of plans. Alternatives and their resultant impacts included various methods of coastal protection for the purpose of reducing erosion that causes the loss of hundreds of acres of SAV habitat and wetlands. Assessments are presented for geotechnical, cultural, environmental, economic, and engineering investigations.

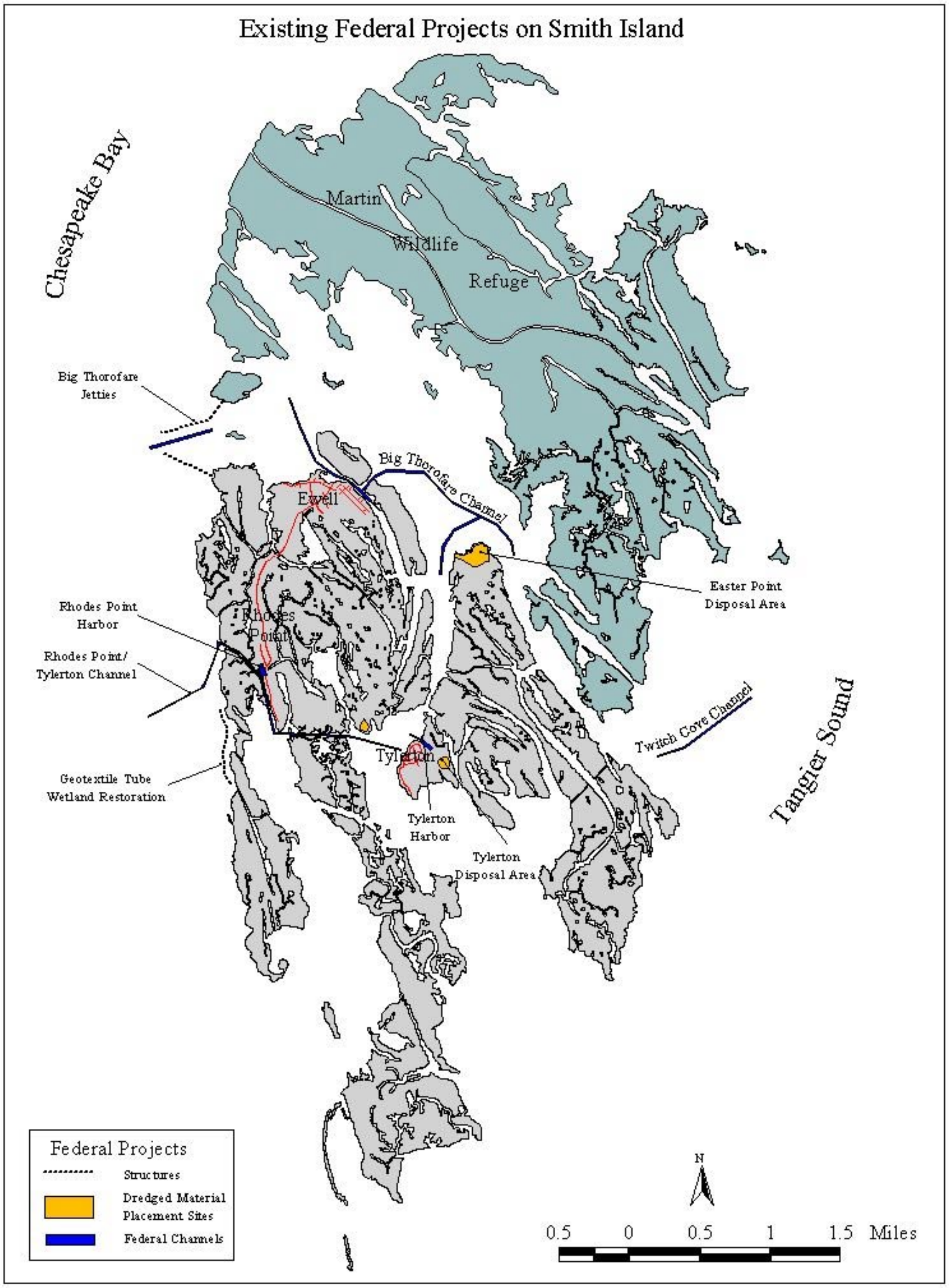
1.5 PRIOR STUDIES, REPORTS AND PROJECTS

The USACE has studied Smith Island several times in the past. The most recent time, not including the May 1997 reconnaissance report that led to this effort, was in the late 1970s and early 1980s. The Flood Control, Shore Erosion Control and Navigation, Smith Island, Maryland and Virginia Feasibility Report, dated June 1981, recommended construction of a channel from Tylerton to Rhodes Point and then to the Chesapeake Bay. The report also recommended that the channel entrance to the Bay be protected by jetties, and for the landmass of Hog Neck to be protected by a series of segmented breakwaters. The structural aspects of the recommendation, the jetty and the breakwaters, were never constructed due to a lack of local funding; however, the channel was constructed through Sheep Pen Gut.

Other USACE projects constructed on Smith Island include (Figure 1.3):

1. A channel, 7 feet deep and 60 feet wide, from Twitch Cove on Tangier Sound through Big Thorofare (authorized by the River and Harbor Act of 25 July 1912, completed in 1913), thence to the canal at Ewell (authorized by the River and Harbor Act of 3 July 1930, completed in 1931), thence through Levering Creek and Big Thorofare to the vicinity of Swan Point (now Swan Island), thence of the same depth and 100 feet wide through the offshore bar to deep water in the Chesapeake Bay, with twin jetties at the entrance (authorized by the River and Harbor Act of 20 June 1938, completed in 1940). These jetties were rehabilitated by the USACE to restore the design template of the project. This effort was completed in 2000.

Figure 1.3: Federal Projects on Smith Island



2. An anchorage basin 7 feet deep, 100 feet wide, and 700 feet long connecting with the west side of the existing project channel at Ewell (authorized by the River and Harbor Act of 17 May 1950). This effort was completed in 1956.

3. An extension of the existing project channel in Levering Creek, 6 feet deep, 60 feet wide and 1,000 feet long (authorized by the River and Harbor act of 17 May 1950). This effort was completed in 1956.

4. A channel 50 feet wide and 6 feet deep from that depth in Tyler Creek to and including an anchorage basin of the same depth, 150 feet wide, and 400 feet long at Tylerton (authorized under the authority of Section 107 of the River and Harbor Act of 1960 on 1 August 1968). This effort was completed in 1970.

5. A channel 50 feet wide and 6 feet deep from that depth in Shanks Creek to and including an anchorage basin of the same depth, 100 feet wide, and 400 feet long at Rhodes Point (authorized under the authority of Section 107 of the River and Harbor Act of 1960 on 1 August 1968). This effort was completed in 1970.

6. A channel 6 feet deep and 50 feet wide from that depth in Big Thorofare River to Tylerton (authorized by the River and Harbor Act of 25 July 1912, modified by authority of Section 107 of the River and Harbor Act of 1960 on 1 August 1968). This effort was completed in 1970.

7. A channel 6 feet deep and 50 feet wide from Rhodes Point to Tylerton (authorized by the River and Harbor Act of 1954 and modified under the authority of Section 107 of the River and Harbor Act of 1960 on 1 August 1968). This effort was completed in 1970.

8. A channel 6 feet deep and 50 feet wide from the northern limit of the Rhodes Point to Tylerton Federal channel through Sheep Pen Gut to deep water in Chesapeake Bay (authorized 22 January 1982 under the continuing authority of Section 107 of the River and Harbor Act of 1960). This effort was completed in 1982.

As part of the maintenance of the above projects, the Baltimore District USACE has, in 1994 and 1997, placed geotextile tubes filled with dredged material and backfilled with additional dredged material, along Hog Neck (Figure 1.3). The backfilled material has been planted with marsh vegetation. The created land has halted erosion along Hog Neck and helped to protect the town of Rhodes Point from imminent danger that would be caused by a breach in the Hog Neck peninsula. Although the geotextile tubes have had mixed success, many have been damaged and collapsed, the created land has been stable. Future dredging operations will likely continue to yield such projects, likely in the same area to replace the damaged tubes and to expand the area of wetlands creation.

The USACE is also in the process of implementing the Tylerton Shoreline Erosion Control Project under Section 510 of WRDA 1996. This process is discussed in greater detail in Section 3.2. The project includes 2,200 feet of bulkhead along the western shoreline, and may include stone erosion control structures to the south of the town. Construction is scheduled for early 2001.

Somerset County has constructed docks for communal and visitor usage at each of the towns. The County has also constructed boat launches and other amenities, such as bulkheading at each of the three towns, for the benefits of the citizens of Smith Island.

1.6 REPORT AND STUDY PROCESS

Planning by the USACE for Congressionally authorized Federal water resources projects is accomplished in two phases: a reconnaissance phase and a feasibility phase. The reconnaissance phase is conducted at full Federal expense, while the cost of the feasibility phase is shared equally between the Federal government and the non-federal sponsor, or sponsors in this case.

1.6.1 Reconnaissance Phase

The objectives of the reconnaissance phase of the Smith Island Environmental Restoration and Protection Study were to (1) investigate the need for improvements to the island within the scope of the study authority, (2) to determine the Federal interest in continuing the study into the next phase, (3) to identify a non-Federal sponsor in support of the potential solutions, and (4) to negotiate and execute a feasibility cost-sharing agreement (FCSA) with the non-Federal sponsor. The reconnaissance report contains a summary of investigations, results, conclusions, and recommendations of the reconnaissance phase and was completed in May 1997. A summary of the reconnaissance phase study process and conclusions follows.

During the reconnaissance phase, the USACE study team conducted exhaustive searches of existing information pertaining to Smith Island, including reviewing prior studies, holding meetings with various interested agencies and groups, and having conversations with the local residents. After meetings with each of the island's three communities, the study team compiled a list of identified problems. These problems included issues such as erosion control, habitat loss, navigation difficulties, flooding, and storm protection, along with quality of life issues such as problems with roads, emergency services, and declining population. Although many of the problems were beyond the jurisdiction and study authority of the USACE, the information was critical to forming the close working relationships that are required when there is no local representative government. It was discovered early on that the people of the island and the natural resources of the island are inextricably linked. The island wetlands provide employment for a culture of watermen, protection from the dangers of the open water, and vital wildlife habitat that benefits the entire Chesapeake Bay and the even larger flyways of the migratory birds and waterfowl.

Given the link between human welfare and wildlife habitat, the local residents greatly value the SAV and wetlands that are abundant around their island. A major concern is the constant loss of land to the Bay and the downward trend in SAV coverage. The reconnaissance report lists many non-environmental concerns of the citizens that were beyond the jurisdiction and study authority of the USACE; however, two recommendations involving more traditional USACE missions were identified and considered further during the feasibility phase. These plans, the Tylerton shoreline erosion control plan, the Rhodes Point navigation plan, and the Martin National Wildlife Refuge environmental restoration plans are discussed below. The recommended project from the reconnaissance study is shown in Figure 1.4. These study areas were considered in greater detail during the feasibility phase.

1.6.1.a Tylerton. During the reconnaissance phase of study, the town of Tylerton was determined to be at great risk from continued erosion. The existing bulkheading along the western shoreline was a combination of many efforts over many decades, but was generally in disrepair. The erosion along the shoreline threatened the road, utilities, and houses. The southern end of town is marshland with no buildings or roads. This area is eroding quickly, which results not only in the loss of wetland and SAV habitat, but increases the frequency of nuisance flooding in the town by allowing extreme high tides to impact the developed area from the south and east. Several alternative plans were considered for Tylerton. The final two alternatives for the western shoreline were timber bulkheading and stone revetment along the entire 2,200-foot shoreline. For the purposes of the reconnaissance study, the stone revetment was recommended due to its longevity and better habitat value. For the southern end, offshore segmented breakwaters were recommended. The breakwaters could be made of stone or geotextile tube, though geotextile tube was put into the final reconnaissance plan due to its lower cost. This plan was carried into the feasibility study for further consideration. The reconnaissance report also recommends Section 510 of WRDA 1996, Chesapeake Bay Environmental Restoration and Protection Program, for implementation; however, the plan was carried into the next phase of study as part of the larger feasibility study effort. Approval to switch implementation authority was granted during the feasibility study phase and is discussed later in this report. The final construction plan is shown in Figure 1.5 (note that the plan now includes a bulkhead to the west and a nearshore stone structure to the south).

1.6.1.b Rhodes Point. After the 1981 feasibility effort, and subsequent authorization under Section 107 of the River and Harbor Act of 1960, as amended, the channel from Rhodes Point to deep water in Chesapeake Bay through Sheep Pen Gut was constructed to allow for safe, reliable navigation for the many watermen who used the gut. The channel is 6 feet deep and 50 feet wide; however, due to the strong currents, erosion, and resulting littoral drift in the area, the channel does not remain passable just a few months after maintenance. The mouth of the gut is a highly erosive area, and the locals fear that as the mouth opens, the town of Rhodes Point will be more exposed to the open Bay and they will be more at risk of storm damages. The study team studied alternatives involving a single jetty or a pair of jetties. The team also considered realigning the channel since anecdotal data suggested that the channel was not properly aligned to reach deep water efficiently. The reconnaissance report recommended a pair of jetties, with the northern being far longer than the southern, and no change in channel alignment (Figure 1.6).

Figure 1.4: Projects Identified During the Reconnaissance Phase

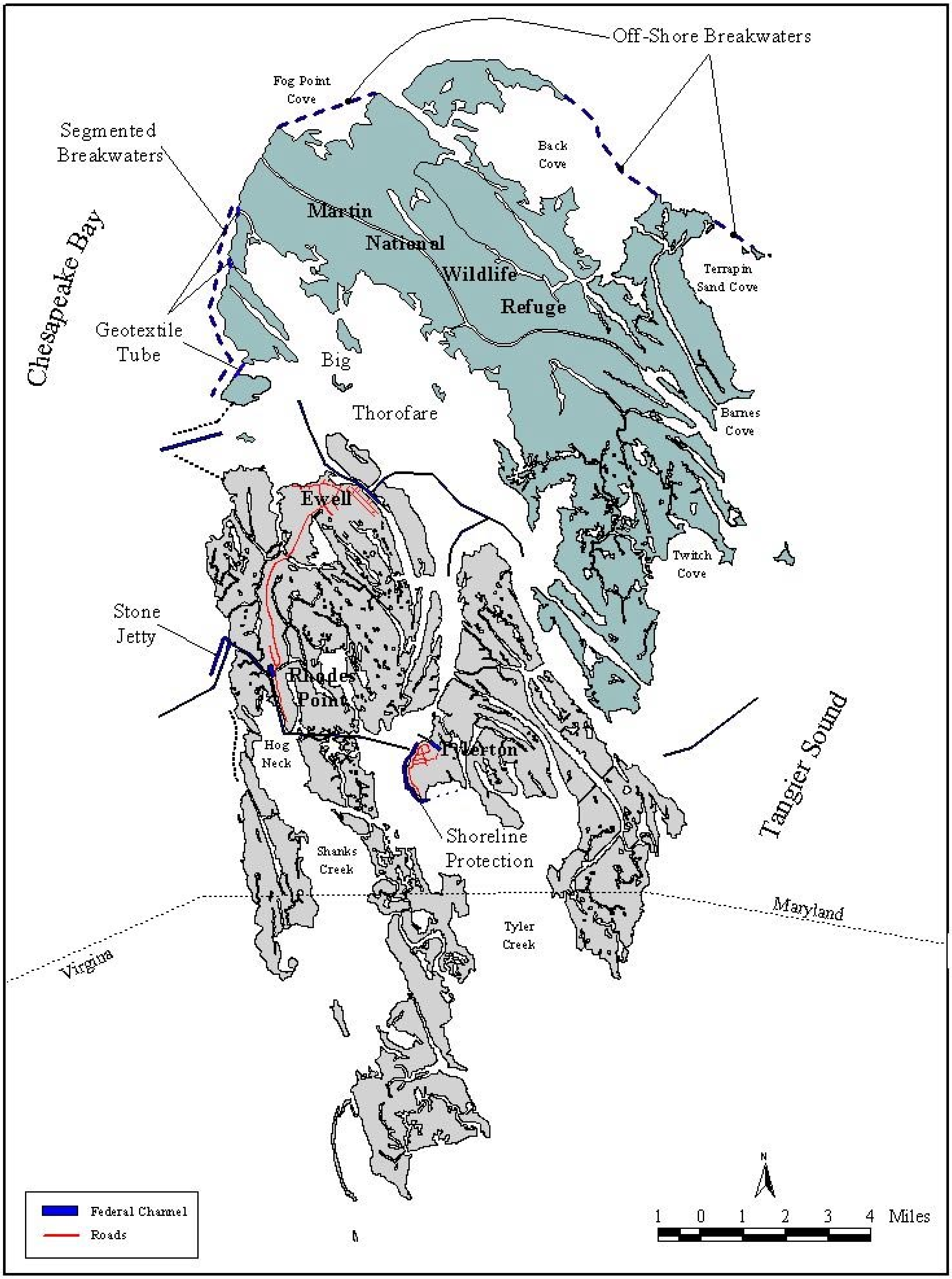

Off-Shore Breakwaters
Fog Point Cove
Segmented Breakwaters
Back Cove
Chesapeake Bay
Martin National Wildlife Refuge
Terrapin Sand Cove
Geotextile Tube
Big Thorofare
Barnes Cove
Ewell
Twitch Cove
Stone Jetty
Rhodes Point
Hog Neck
Tylerton
Tangier Sound
Shoreline Protection
Shanks Creek
Maryland
Tyler Creek
Virgina
Federal Channel
Roads
N
1 0 1 2 3 4 Miles

Figure 1.5: Tylerton Project Recommendations

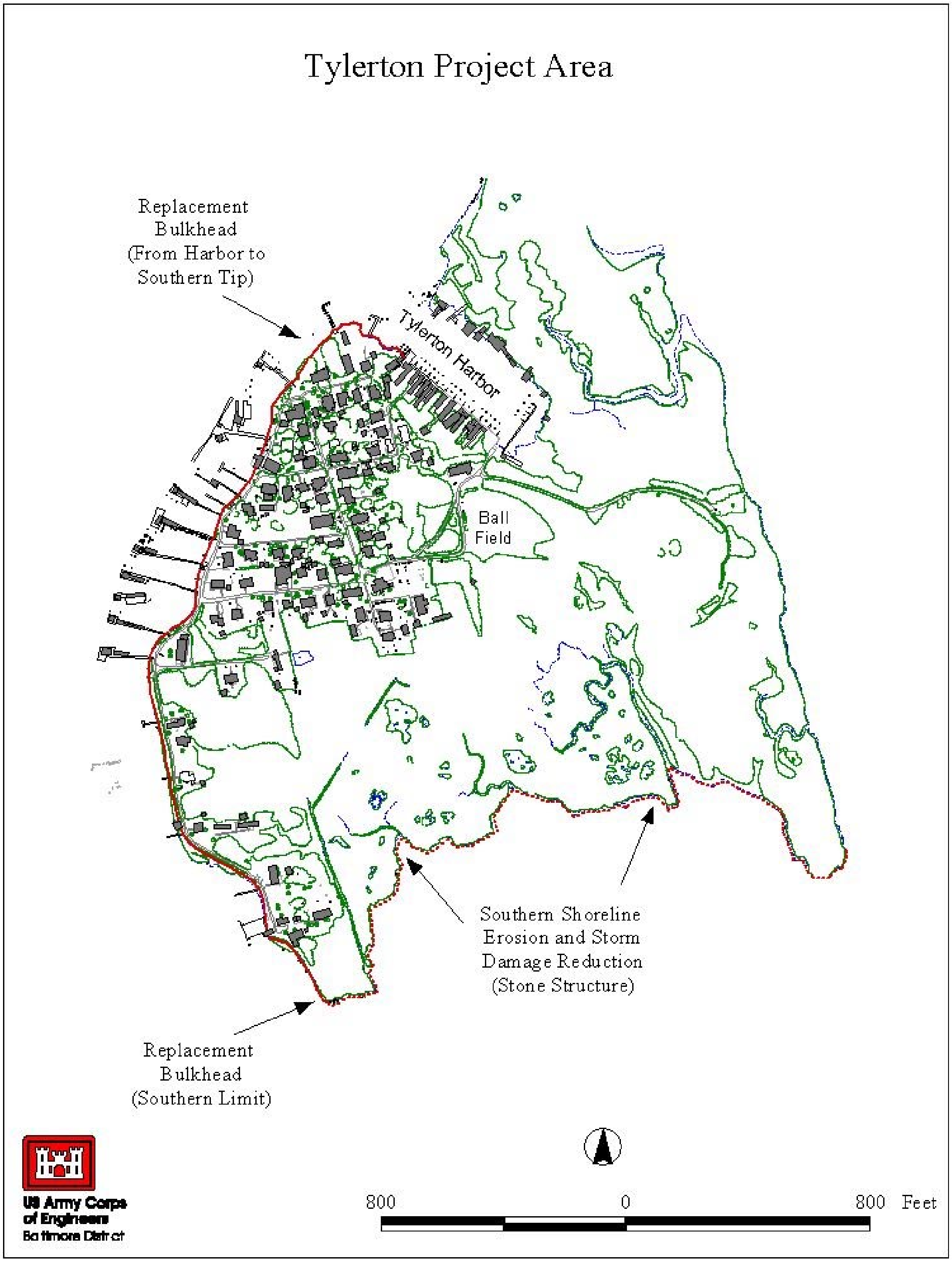
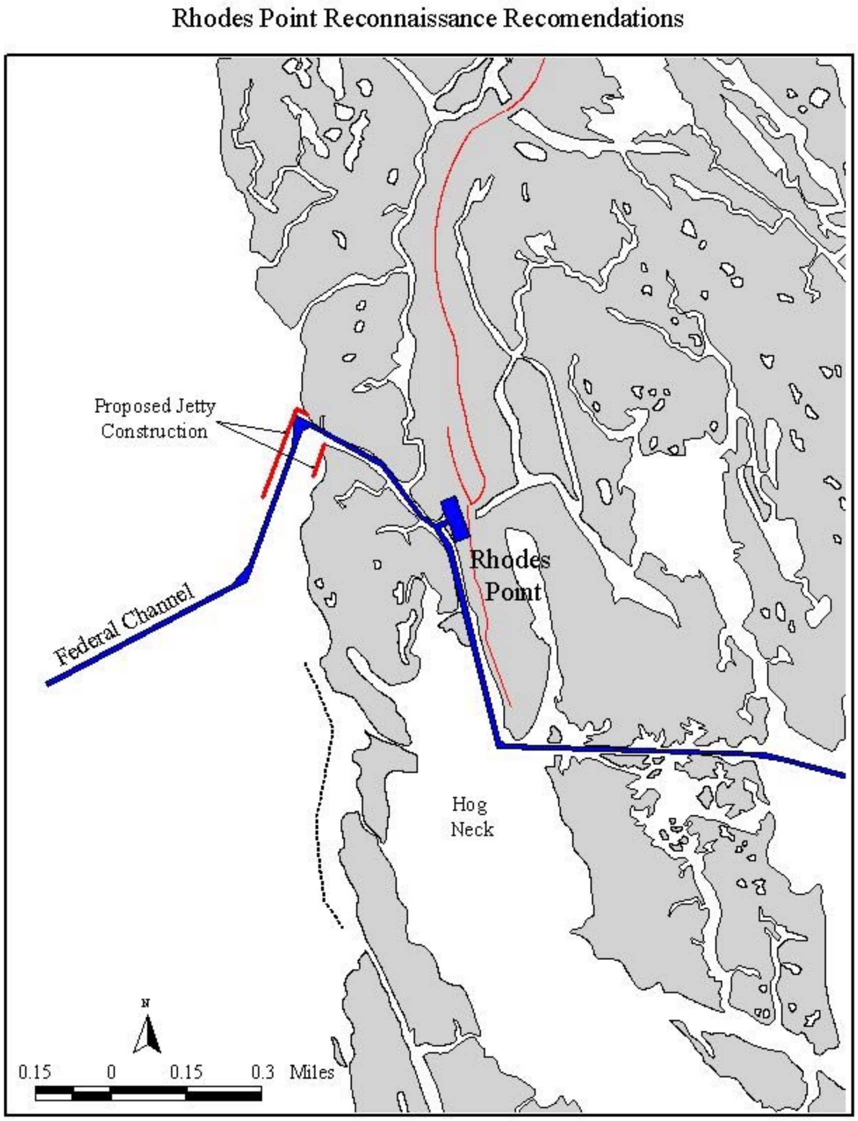


Figure 1.6: Rhodes Point Project



1.6.1.c <u>Martin National Wildlife Refuge</u>. All four recommendations for the Martin National Wildlife Refuge, which is owned by the Federal government, managed by the U.S. Fish and Wildlife Service (USFWS) and administered as part of the Blackwater Wildlife Refuge, are environmental restoration plans. The plans all include the protection of existing SAV and the restoration of viable habitat for the colonization of SAV. Through public coordination efforts with the residents of Ewell during the reconnaissance phase, it was determined that the most pressing need in the area was to repair the breaches along the western shoreline of the Martin National Wildlife Refuge (Figure 1.7). Residents from Ewell and representatives from USFWS agreed that these breaches are causing, or at least exacerbating, the loss of

SAV in Big Thorofare and causing increased rates of shoaling in the Federal channels in the area. The increased wave action is becoming a hazard to navigation as well as causing increased rates of erosion to portions of Ewell.

Alternatives were developed to repair the breaches and stabilize the western landmass to protect the waters of Big Thorofare from sedimentation and wave energy. One alternative included placing geotextile tubes to the outside (Bayside) and inside (Big Thorofare side) of the breach and filling in between with dredged material. The created land would then be planted with wetland vegetation. Another plan involved the construction of offshore, segmented breakwaters. These breakwaters would be made of stone or geotextile tubes. Alternative plans were considered to protect only the southern end of the peninsula and to protect the entire length of the peninsula. It was recommended that the breach repair and segmented breakwaters should both be carried into the feasibility phase as a single project.

The coves along the north and east shorelines of the Martin National Wildlife Refuge were found to be in various states of degradation. Although the coves have remained somewhat productive, they have lost habitat value due to erosion of the protective landmasses and are in danger of further degradation. Fog Point Cove, Back Cove, and Terrapin Sand Cove have all shown a decrease in SAV since the early 1990's. Although there are other coves that could potentially be repaired, these three were chosen and studied further in the feasibility phase due to their high ecological value and uncertain future. It was recommended that the coves be reformed using armor stone breakwaters or geotextile tubes to protect them from the open water (Figure 1.7). The breakwaters would be 100 feet in length and would be segmented with 100-foot gaps in between.

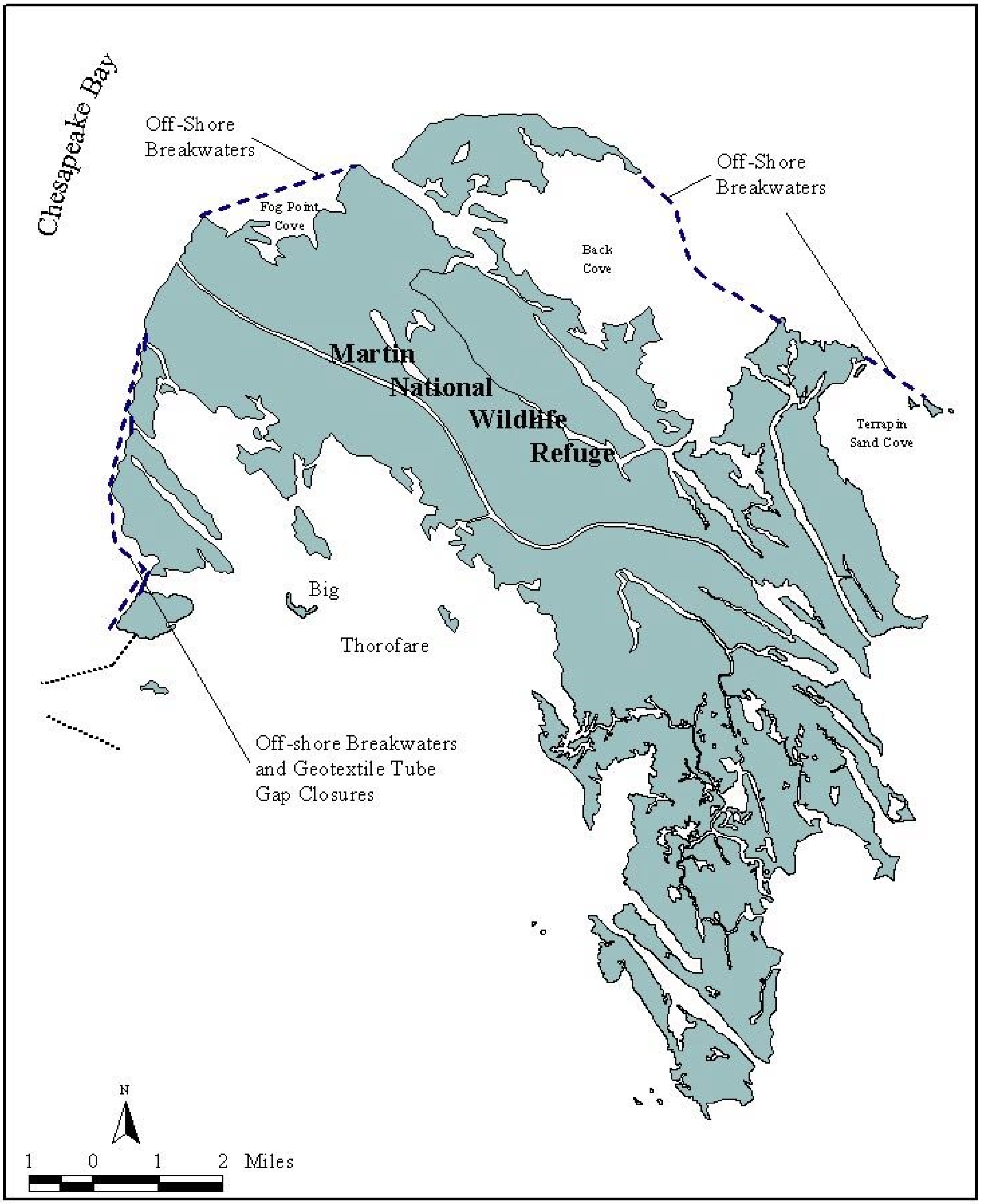
1.6.1.d Feasibility Cost-Sharing Agreement. Based on the conclusions of the reconnaissance report as discussed above, the Maryland Department of the Environment (MDE), the Maryland Department of Natural Resources (MdDNR), and Somerset County agreed to be non-Federal sponsors for the feasibility phase. The sponsors entered into an agreement with the United States Government to share in the costs of the feasibility phase. This Feasibility Cost-Sharing Agreement was executed in May 1998.

1.6.2 Feasibility Phase

The objectives of the Smith Island feasibility study were to (1) evaluate the specific engineering, environmental, and economic effects of alternative environmental restoration plans compared to a without-project condition; (2) identify the optimum plans from both Federal and non-Federal perspectives; and (3) recommend a project for construction, if economically, environmentally, and technically justified and supported by the non-Federal sponsors. A product of the feasibility phase is the feasibility report with the appropriate environmental documentation, which is submitted to the U. S. Congress for project authorization. The feasibility study focused on preserving and restoring critical SAV and wetlands habitat, and improving and maintaining the unique culture of Smith Island that relies on these resources. This report and EA is a decision document for the feasibility phase of the Smith Island Environmental Restoration and Protection

Study. The following sections describe, in detail, the efforts and conclusions of the feasibility study.

Figure 1.7: Martin National Wildlife Refuge with Reconnaissance Project Recommendations



The feasibility study began in June 1998 and culminated with this report two and a half years later. The study was conducted in cooperation with the State of Maryland and Somerset County, who, together, funded half of the $1,256,000 study cost. This feasibility study recommends four projects for implementation under the Corps of Engineers General Investigations and Construction General programs. These programs require Congressional approval and funding for implementation. Further, two plans, the Tylerton Shoreline Erosion Protection plan and the Rhodes Point Navigation Plan, have been removed from this process and are being considered under separate authorities. The details of the project alternatives considered and technical analyses evaluations are discussed in this report as well as the future tasks that will be undertaken to implement the report recommendations.

Section 2

Existing Conditions

2.1 PHYSICAL SETTING

2.1.1 Ewell, Tylerton and Rhodes Point

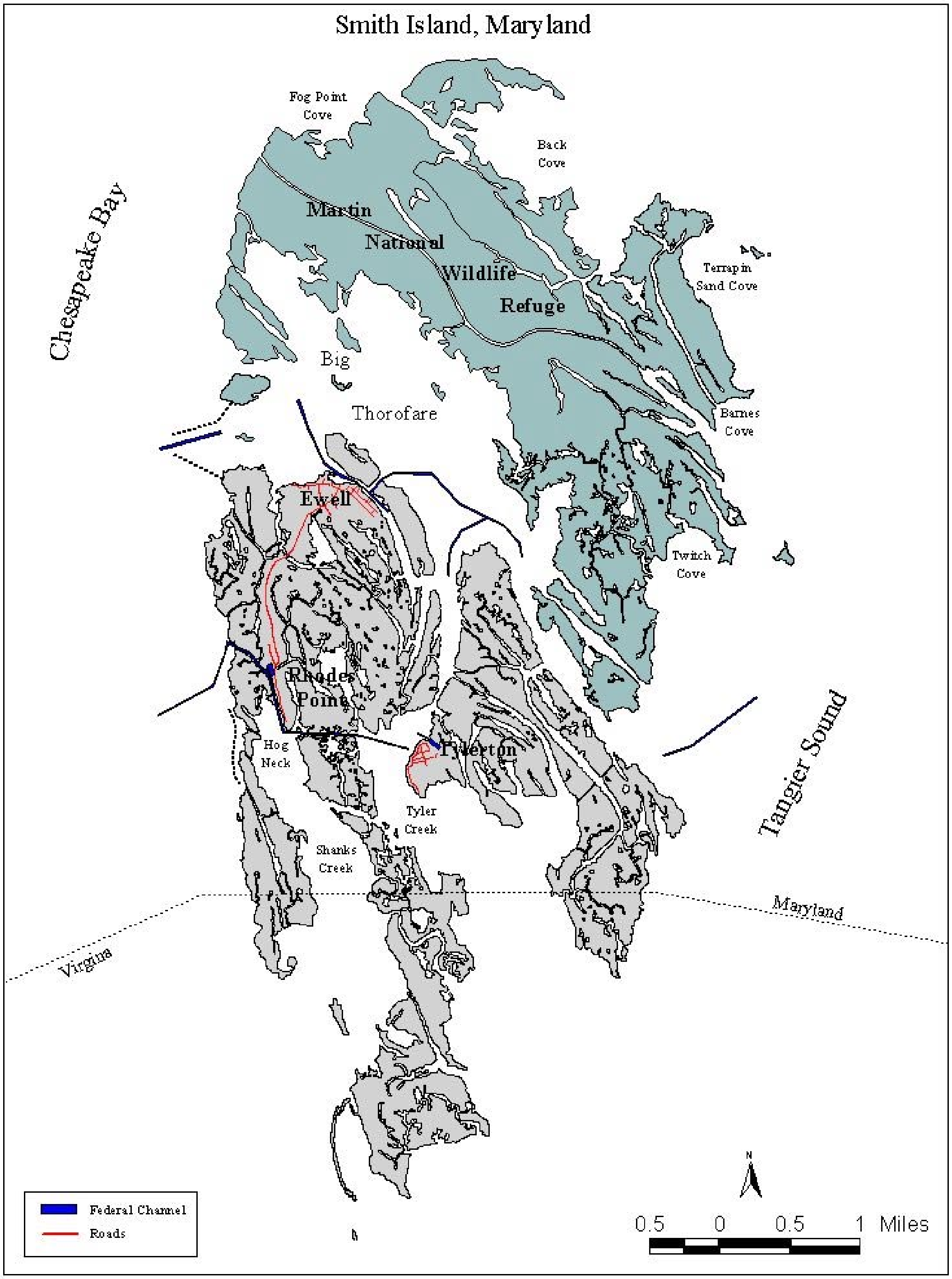
Smith Island is situated 12 miles west of Crisfield, Maryland, and 95 miles south of Baltimore, Maryland (Figure 2.1). Smith Island is bounded to the east by Tangier Sound, to the west by Chesapeake Bay, and straddles the Maryland/Virginia border. Smith Island lies mostly in Somerset County, Maryland, although the southern tip lies in Accomack County, Virginia. The island is approximately 8,000 acres in area and is 8 miles long and 4 miles wide.

The island has three towns: Ewell, Tylerton, and Rhodes Point; all are located on the southern half of the island, south of Martin National Wildlife Refuge. The three towns are within the Maryland portion of the island (Figure 2.1). Rhodes Point is connected by road to Ewell. Tylerton is located about a mile east of Rhodes Point by boat. Ewell is the largest town and has more amenities than Rhodes Point or Tylerton. These three towns represent the last inhabited Chesapeake Bay communities in Maryland that are accessible only by boat. Except for these three communities, Maryland's other inhabited islands in the Bay are now connected by bridges to the mainland.

2.1.2 Martin National Wildlife Refuge

The northern part of Smith Island constitutes the Martin National Wildlife Refuge. The refuge includes approximately 4,500 acres of undeveloped marshes, shores, and upland areas. The marsh areas are ecologically valuable as habitat for birds, invertebrates, fish, reptiles, and mammals and for their role in local and regional nutrient cycling. Most of the refuge is composed of estuarine emergent wetlands bisected by numerous tidal creeks. Of the 12 hammocks on the island that contain important wading bird rookeries on the island, three are within the refuge boundaries. Several other wooded ridges, dunes, and former dredged material disposal sites in the refuge provide upland nesting sites for colonial waterbirds, waterfowl, and raptors. These sites also provide important resting and staging areas for migratory songbirds. These sites are especially valuable because development, human disturbance, cultivation, and exposure to predation by domestic animals on nearby mainland areas has diminished and threatened such critical habitat elsewhere. Scarcity of useable habitat has become a major problem in the Chesapeake Bay region and highlights the need to protect and expand, where possible, the resources of the Martin National Wildlife Refuge. Two pairs of threatened American peregrine falcons are currently using nesting towers in the refuge.

Figure 2.1: Location Map of Smith Island, Showing the Towns, Coves, and Martin National Wildlife Refuge.



2.2 EXISTING ECOLOGICAL PROFILE

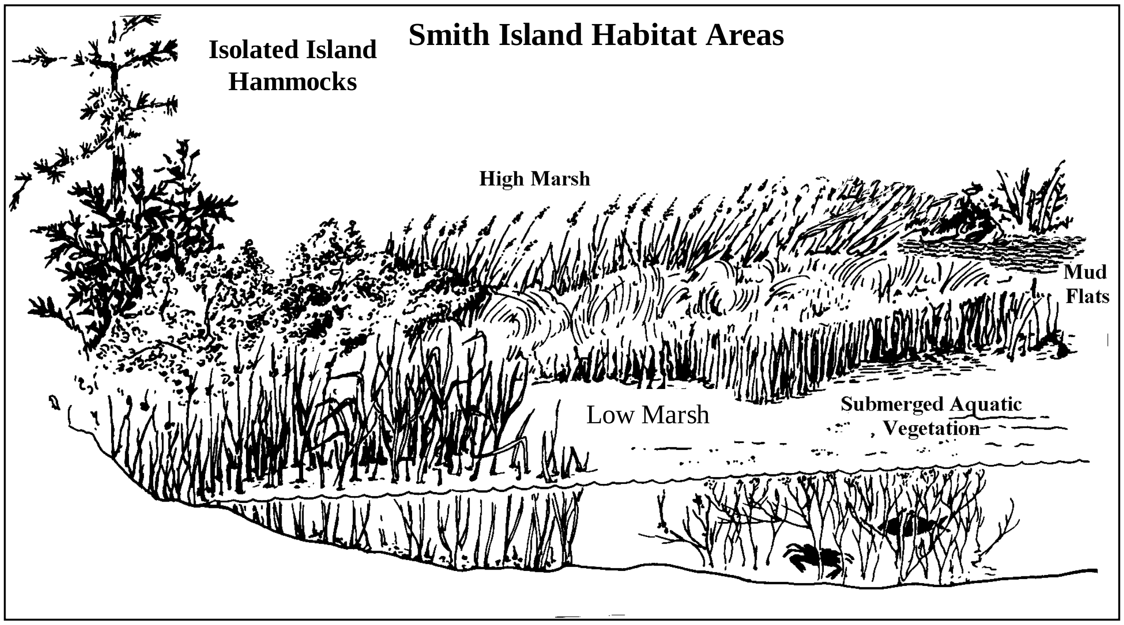
Smith Island is a dramatic mix of submerged aquatic vegetation (SAV), estuarine wetlands and scattered upland hammocks, appearing like islands of high ground within vast expanses of high and low marsh. At low tide, large mudflats ring the low marsh and blur the distinction between land and water. The result is an ecological system that provides an exceptional diversity of salt marsh vegetation and its associated wildlife. As a result, Smith Island is a haven to dozens of bird species and is one of the most important blue crab fisheries in the United States. The vast majority of the island is wetland, with only isolated patches of upland. The wetlands that surround small upland areas and are surrounded by mud flats and SAV create a diverse and productive habitat that is graphically represented in Figure 2.2.

2.2.1 Wetlands

Two types of wetlands were identified on Smith Island, based on elevation: emergent marsh and SAV. SAV is considered a wetland by the USFWS, and, therefore, is considered a type of wetlands for the purposes of this report. Emergent marsh refers to the wet areas that are dominated by grasses, sedges, and other herbaceous or non-woody plants, an area that comprises the vast majority of the Smith Island ecosystem. The emergent wetlands blend into a few scattered upland areas, dominated by small trees and shrubs. These areas are discussed in section 2.2.7. No scrub/shrub wetlands or forested wetland exist, as the wet areas are dominated by emergent vegetation. Below the water level are SAV beds, areas of submerged seagrasses, typically found in water of less than one meter in depth. The Tangier Sound SAV beds are considered one of the largest and most important SAV beds in the Chesapeake.

2.2.1.a Emergent. The emergent wetland vegetation on Smith Island is expansive and extremely valuable, comprising nearly 7,000 acres of marsh. For this reason, half of the island was declared a National Wildlife Refuge, comprising the northern 4,000 acres of the island, and is managed by the USFWS. A vast majority (7,000 acres out of 7,500 acres) of the island is tidal marsh, surrounding small, scattered upland areas, which serve as islands in the marsh. The largest upland areas contain the towns of Ewell, Rhodes Point, and Tylerton. Smaller patches of uplands exist within the marsh. These upland islands, called hammocks, are used extensively by the colonial waterbird populations and other wildlife. The system of upland breeding sites, combined with extensive tracts of tidal marsh, make Smith Island extremely important to migratory and colonial nesting birds. Smith Island serves as an important stopover site during the spring and fall migrations and hosts year round populations of nesting birds. The small human population of Smith Island, combined with the remote location, eliminates many human-induced impacts on the emergent wetlands. Thus, the emergent marsh on Smith Island is one of the premier marsh systems within the Bay watershed in terms of wildlife habitat value. Despite the quality of the marsh, the marsh is severely threatened by continued marsh erosion, which has claimed nearly 3000 acres over the last 150 years. Continued erosion throughout the marsh system will severely reduce the size and quality of the marsh and undermine the viability of the island ecosystem.

Figure 2.2: Smith Island Habitat Areas



Source: Adapted from Lippson and Lippson, 1997

Figure 2.3: Emergent Marsh along the Western Shoreline of Smith Island

The majority of the emergent vegetation is black needlerush (*Juncus roemerianus*), rarely found in pristine condition, as in Martin Wildlife Refuge. Other Species located with the Smith Island area are smooth cordgrass (*Spartina alterniflora*), saltmeadow hay (*Spartina patens*), salt grass (*Distichlis spicata*), marsh elder (*Iva frutesccens*), groundsel bush (*Baccharis halimfoilia*), saltmarsh bulrush (*Scirpus robustus*), waterhemp (*Amaranthus cannabinus*), and common reed (*Phragmites australis*). Common reed, an invasive wetland plant of relatively low wildlife value, is associated with a number of disturbed sites, including some dredged material disposal sites, scattered throughout the island. Common reed is not found in the natural wetland areas of the island, and is known to rapidly colonize disturbed marshes.

A functional assessment using the Evaluation for Planned Wetland (EPW) methodology was conducted in summer 2000 by representatives of the USFWS and USACE. The Smith Island marshes were ranked highly for the following functions and are discussed below:

- wildlife habitat
- sediment stabilization
- water quality
- flood control
- uniqueness/heritage.

Wildlife Habitat

Wetlands comprise critical habitat for an extensive number of species, especially fish, shellfish, waterfowl, shorebirds, wading birds, and mammals. These species include striped bass, menhaden, flounder, oysters and blue crabs. Each of these are commercially important and depend upon tidal wetlands. The wetlands at Smith Island, protected from human activity and mainland predators, is exceptional habitat for these species and supports large populations of these organisms.

Sediment Stabilization

Wetland grasses, with their extensive root mats, provide an anchor for the fine particles that comprise marsh sediments. Without vegetation, wetlands soils are highly erosive and can contribute extensive sediments to the bay. The grasses serve to stabilize the sediment, acting as a buffer for wave and tidal energy, and developing a root mat that anchors the actual particles in place. For this reason, wetland vegetation is often used as a source of erosion control. At Smith Island, the extensive grassland cove and associated root mats provide an important defense against further erosion.

Water Quality

Wetlands serve as extensive sinks of nutrients, and have been shown to absorb up to 80 percent of phosphorous and 90 percent of nitrogen, fixing these nutrients in the soil and using them for marsh growth. The result is that wetlands are a critical nutrient sink within the Bay ecosystem, helping to prevent algae blooms and the associated eutrification and fish mortality. In addition, the wetlands can minimize the sediment loads through their stabilization functions and help remove contaminants from the water.

At Smith Island, the extensive wetlands provide critical nutrient removal and anchor a large amount of solid particles, making them an important resource to the overall Bay.

Flood Control

Wetlands often act as natural sponges that absorb flooding waters, slowing runoff and reducing the amount of flooding. These functions are critical in urban and agricultural areas. On Smith Island, with the low levels of development, these functions are less important, although it is clear that without the marshes of Smith Island, flooding would be an even larger problem for the local communities.

Uniqueness/Heritage

This function is included within Evaluation for Planned Wetlands (EPW) to reflect the qualitative values of a particular wetland. At Smith Island, the existing wetlands are a key component in an incredible island ecosystem, with associated populations of wildlife. This was recognized by the USFWS through the creation of Martin Wildlife Refuge, providing permanent protection from human development. By creating a refuge, the federal government highlighted the importance of this system to the Bay and to the natural resources of the United States. There are few remaining islands with the wetland/upland hammock island ecosystem remaining within the Bay watershed, making this system rare, if not unique. Thus, the wetlands at Smith Island are considered to have a very high uniqueness and heritage value.

The overall assessment by USACE and USFWS of the emergent wetlands on Smith Island is that the marshes were highly functional, although seriously threatened by wave energy, tidal erosion and longshore sediment transport. This assessment and the assessment procedure are discussed more fully in Appendix A.

Wetlands are a critical component to the overall Chesapeake ecosystem, serving as filtering mechanisms, sinks for nutrients, habitat for wildlife and anadromous fish, flood control, and pathways for migratory birds. Preserving wetlands is an essential component in the management of the Chesapeake Bay and a goal of the Chesapeake Bay Program. Nonetheless, the Chesapeake Bay region has lost significant areas of wetland over the past 50 years, a result of sea level rise, erosion, and human activities. Smith Island is no exception. Since 1850, Smith Island has lost approximately 3,000 acres of land, mostly salt marsh (see NOAA shoreline erosion maps, 1996). In the future, large areas of marsh are expected to be lost in the study areas (Table 2.1). Erosion rates were determined by averaging the length of shoreline lost over time, measured from Maryland Geologic Survey (MGS) assessments of historic shorelines. Shoreline estimates exist for 1849 and 1942. The erosion rates assume a continuation of historic conditions. On average, the wetlands are being eroded by approximately 10 feet per year, more than double the accepted rate for severe erosion in Maryland (4 ft. per year). The fastest erosion rate was observed on the southeast shore of Back Cove and on the western shoreline near Rhodes Point. Over the past 50 years, the shoreline near Rhodes Point has been documented as eroding at 13 feet per year, more than three times the threshold for severe erosion.

Table 2.1: Estimated Wetland Losses by Study Area

	Shoreline Erosion/ Year (ft.)	Wetland Loss/Year (Acres)	Wetland Loss/25 Years (Acres)	Wetland Loss/50 Years (Acres)
Western Shoreline	12	2.7	67.6	135.2
Fog Point Cove	6	0.64	16.0	32.0
Back Cove—NW Shore	10	1.09	27.25	54.5
Back Cove—SE Shore	14	0.74	18.5	36.0
Terrapin Sand Cove	4	0.23	5.8	11.6
Rhodes Point	13	1.53	38.25	76.5
TOTAL	**9.83 (average)**	**6.93**	**173.25**	**346.5**

(calculated from MGS shoreline erosion maps, 1999)

Marsh erosion within the study areas is expected to be approximately 346 acres over the next 50 years. This does not include the areas outside of the study area, which would bring the total to approximately 1,000 acres over the next 50 years. This represents a major problem for the ecosystem, the local communities, and the Bay region in general. The wetlands at Smith Island support a tremendous wildlife population, including numerous colonial waterbirds, shorebirds, and waterfowl, as well as anadromous fish and crabs. The loss of hundreds of acres of pristine, highly functional wetlands represents a major loss of habitat value and ecosystem function to the Bay region.

2.2.1.b Submerged Aquatic Vegetation. Historically, over 600,000 acres of SAV were thought to have grown in the Chesapeake Bay. However, Bay-wide, there have been less than 80,000 acres in the Bay every year since the 1960s. The Bay-wide decline has been linked to eutrophication, disease, and an increase in total suspended solids (TSS). TSS is thought to play an important role in the decline of SAV in Tangier Sound and near Smith Island (Koch, 2000). High levels of TSS negatively impact SAV by blocking sunlight that is critical to the survival of the plants.

The implementation of nutrient controls throughout the Bay has increased the total acres of SAV coverage in many areas, especially the upper Bay. However, the Tangier Sound area has not followed this trend and showed a decline from 1992 when there was approximately 18,000 acres to 1998 when there was only about 7,000 acres. Although SAV is thought to have increased slightly in 1999 and 2000, data from these years was not available for this report. Nonetheless, Tangier Sound has not kept pace with the trends in other areas of the Bay. A major local factor in the decline in Tangier Sound is the extensive shoreline erosion that increases TSS, reduces light availability to the SAV and increases wetland loss. Table 2.2 shows the habitat requirements for SAV.

Table 2.2: SAV Habitat Requirements by Salinity Regime. Smith Island is entirely within the Mesohaline area of the Bay.

Salinity Regime	Light attenuation Coefficient (Kd: m-1)	Secchi Depth (m3)	Total Suspended Solids (mg/l)	Chloro-phyll a (ug/l)	Dissolved Inorganic Nitrogen (mg/l)	Dissolved Phosphorus (mg/l)	Critical Life Period
Tidal Fresh (<0.5 ppt)	< 2	> 0.7	< 15	< 15	n/a	< 0.02	April - October
Oligohaline (0.5-5 ppt)	< 2	> 0.7	< 15	< 15	n/a	< 0.02	April - October
Mesohaline (>5-18 ppt)	< 1.5	> 1.0	< 15	< 15	< 0.15	< 0.01	April - October
Polyhaline (> 18 ppt)	< 1.5	> 1.0	< 15	< 15	< 0.15	< 0.02	March-May, September-November

(Source: Chesapeake Bay Program, 2000)

SAV is among the most valuable aquatic resources in Chesapeake Bay. SAV species are also termed 'bay grasses' or 'seagrasses,' and refer to the rooted vascular plants that inhabit shallow coastal water. The Chesapeake Bay provides extensive areas conducive to SAV growth. SAV habitat is predominately shallow water (less than 3 feet deep at low tide), with sandy substrate. On average, the Chesapeake Bay contains between 50,000 and 70,000 acres of SAV, making it one of the largest concentrations of SAV in the United States. Within the Chesapeake, the dominant species are eelgrass (*Zostera marina)* and wigeon grass (*Ruppia maritima)*, and both species have been recognized by the scientific community and Chesapeake Bay Program as extremely important to the overall ecology of the Chesapeake Bay. Koch (1999) has identified SAV as contributing the following functions to the Bay:

- Primary Production
- Fisheries Habitat
- Nutrient Uptake
- Wave Attenuation
- Reduction in current velocity
- Sediment Stabilization

<u>Primary Production</u>

SAV functions as an important source of primary production, converting sunlight and nutrients into the staples of the food chain. SAV is most commonly consumed by waterfowl, especially ducks, geese, and swans. However, epiphytes growing on the seagrass leaves appear to be an important food source for a variety of organisms, such as blue crabs and plant-eating fish (van Montfrans et al., 1984). In addition, decaying SAV is a major source of food for numerous zooplankton, the overall base of the Bay food chain.

Related to primary production is the fact that SAV increases the levels of oxygen in the water column, effectively increasing the biological potential of the Bay. The lack of dissolved oxygen, typically resulting from algae blooms, is often cited as a major problem within the Bay and strong SAV beds serve to counteract this process by adding oxygen.

Fisheries Habitat

The importance of SAV to the fisheries of the Chesapeake Bay cannot be understated. SAV beds have been identified as one of the most productive habitats within the Bay ecosystem (see Lubbers, et al, 1990; Sogard and Able, 1991). One hectare of SAV has been estimated to contain approximately 107,000 blue crabs, an estimated concentration that is 30 times greater than non-vegetated areas of the Bay (Koch, 1999: 4). SAV provides a higher abundance of organisms and a greater variety of organisms than non-vegetated areas. These attributes are a result of the primary productivity and the refuge that SAV provides for juvenile fish. Basically, SAV provide the food and the shelter required by a number of species, including pipefish, seahorses, sticklebacks, anchovies, silversides, shrimp, blue crabs and clams. SAV provides the nursery conditions for many commercial and non-commercial fish, including menhaden, shad, spot, croaker, and red drum.

Nutrient Uptake

Nutrients have been identified as a significant problem within the Bay ecosystem. Excessive nutrients are known to encourage algae blooms, which reduce water clarity and remove dissolved oxygen from the water column. When the system gets low in dissolved oxygen, resident organisms suffer. This may result in lower populations of fish or even fish kills. The two primary nutrients of concern are nitrogen and phosphorous, which are entering the Bay in elevated levels. The excess nutrients are a result of landuse changes, population growth, urban and rural runoff, and marsh erosion.

In the Bay, SAV removes significant amounts of nutrients per year. The exact amount of nutrients removed remains unknown, however it is believed to be important, especially since excess nutrients remain a critical problem as identified by the Chesapeake Bay Program. Increases in SAV coverage throughout the Bay would help toward the nutrient reduction goals that have been established.

Wave Attenuation and Erosion Reduction

SAV buffers the land and surrounding marsh from the wave energy generated throughout the Bay. Eelgrass has been measured to reduce as much as 43% of the wave energy (Fonesca and Cahalan, 1992). Despite its effectiveness in dissipating wave energy, SAV is not able to grow in areas of high wave energy, where the substrate will be resuspended and bury the roots. However, if SAV is established in an area of high wave energy, the SAV is very effective in reducing the energy so that more SAV can colonize. Thus, SAV is typically found in areas of low to mid energy levels.

Another value of the wave attenuating properties of SAV is to provide a buffer to existing tidal marshes, thereby preventing erosion. In the Chesapeake, roughly 13% of the TSS can be attributed to shore erosion, while that number is as high as 52% in the area near Smith Island (Koch, 1999: 5).

Reduction in Current Velocity

Just as SAV is able to absorb wave energy, SAV also reduces current velocity by lowering the momentum of the moving water. The magnitude is dependent on the density of the vegetation in the bed. The reduction in water velocity is important for a number of reasons: (1) stabilizing substrate, effectively reducing erosion and scour, (2) promoting a longer residence time of water to allow for more complete nutrient uptake, and (3) allowing suspended seeds and spores to settle and create a more diverse Bay bottom.

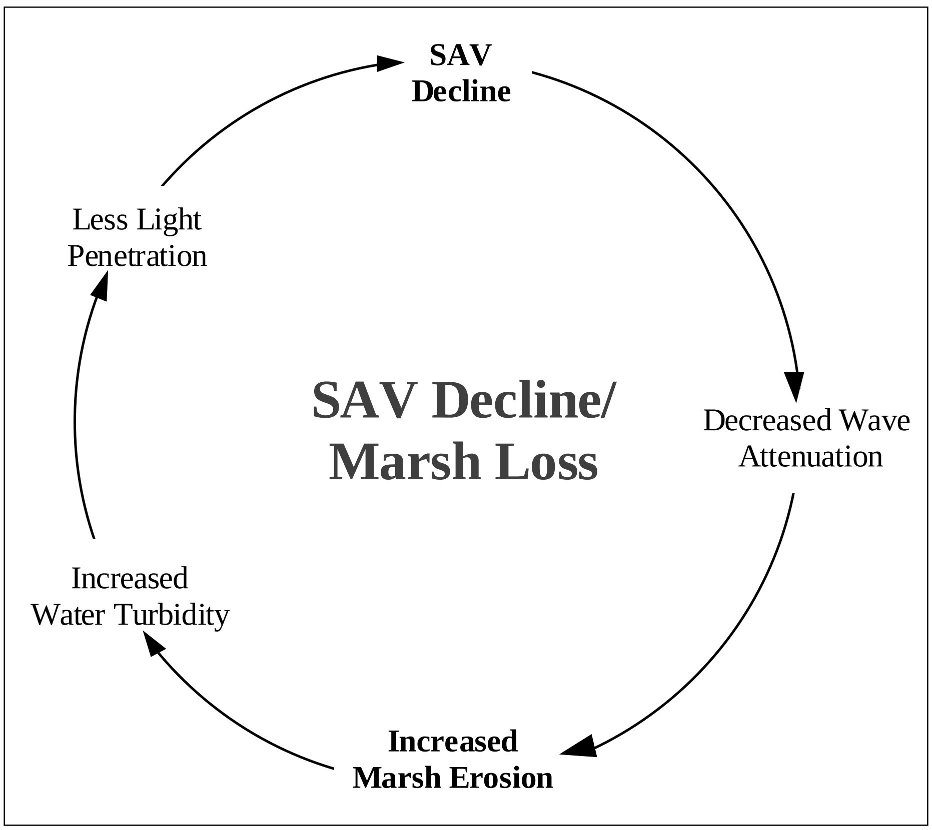
Sediment Stabilization

SAV beds, by reducing current velocities and wave energy, tend to accumulate sediment, offsetting effects of sea-level rise. Eelgrass has been measured to accumulate sediment of rates up to 1 cm per month (Harlin and Thorn-Miller, 1982). In order for the SAV beds to remain viable, they must accumulate at a rate faster than sea-level rise, which is roughly 3.9 mm per year in the mid-Chesapeake. Given healthy SAV beds, sea-level rise does not necessarily pose a significant problem. However, sea level rise may permanently change the substrate by eroding the nearby marsh sediments. Sea level rise and its associated marsh loss may permanently change the depth of the water, preventing light from reaching the Bay floor. This would effectively remove portions of the Bay from potential SAV re-colonization, permanently destroying the habitat. SAV can be an important weapon in the fight against sea level rise, although to be effective, it needs to be healthy and protected from disturbance.

Smith Island SAV Trends

Each of these functions highlights the importance of SAV around Smith Island and within the Chesapeake Bay. In addition, SAV decline has been linked to marsh loss that has been observed in the Smith Island area. The wave attenuation and reduction in current velocity functions serve to help buffer exposed marshes from erosion. SAV is highly variable in distribution, which can be attributed to increased nutrients, decreased water quality, weather conditions or changes, or a host of other regional factors. In years with a substantial SAV decline, it is expected that wave energy will increase, as much of the buffering functions are lost. With increased wave energy, marsh erosion increases, especially along exposed tidal marshes. The marshes, usually composed of fine, organic sediments, erode quickly and increase the amount of TSS in the local shallow water areas. These solid particles damage future SAV growth in two ways. First, the increased TSS limits light penetration in the water column, which prevents the growth of SAV. The soil particles, especially the nutrient-rich marsh sediments, can also encourage growth of algae, which also limits water clarity, effectively reducing SAV habitat. Second, as the fine particles settle to the Bay bottom, they have the potential to choke SAV seed, preventing access to oxygen and light. Furthermore, the eroded marsh contributes nutrients, nitrogen and phosphorous to the Bay waters. The nutrients encourage algae growth and further block the light from reaching the SAV. In addition, marsh erosion changes the substrate from sandy bottom to finer sediments, making long-term SAV colonization more difficult. The result is a vicious circle that encourages further SAV loss and marsh erosion. Since at Smith Island it has been determined that up to 52% of the TSS is from shoreline erosion, it is likely that the best way to break the cycle of SAV loss is to reduce erosion and allow natural recolonization of SAV.

Figure 2.4: Conceptual link between Marsh loss and SAV decline



While there is strong evidence that this process is going on near Smith Island (see Koch, 1999), it is important to recognize that there are numerous other factors and variables that effect SAV distribution and health. It is extremely difficult to separate regional and local factors, and SAV growth has proved extremely difficult to predict. Nonetheless, Smith Island has shown a general decline in SAV and is part of the Tangier Sound SAV bed, which has continued to lag behind other regions of the Bay in terms of SAV regeneration. Figure 2.5 shows the SAV trends for the Chesapeake Bay, while Figure 2.6 shows the regional trend for the Tangier Sound area.

Figure 2.5 Bay-wide SAV Trends (source: MD Department of Natural Resources, 2000).

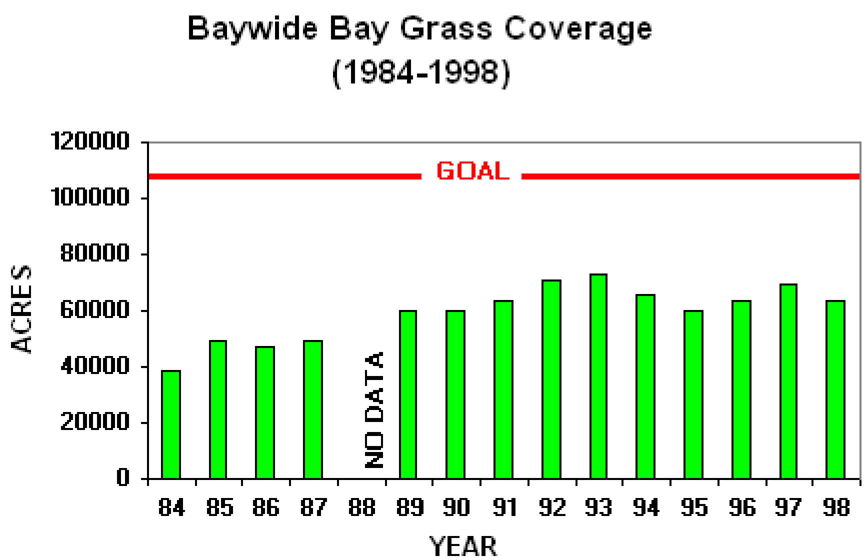
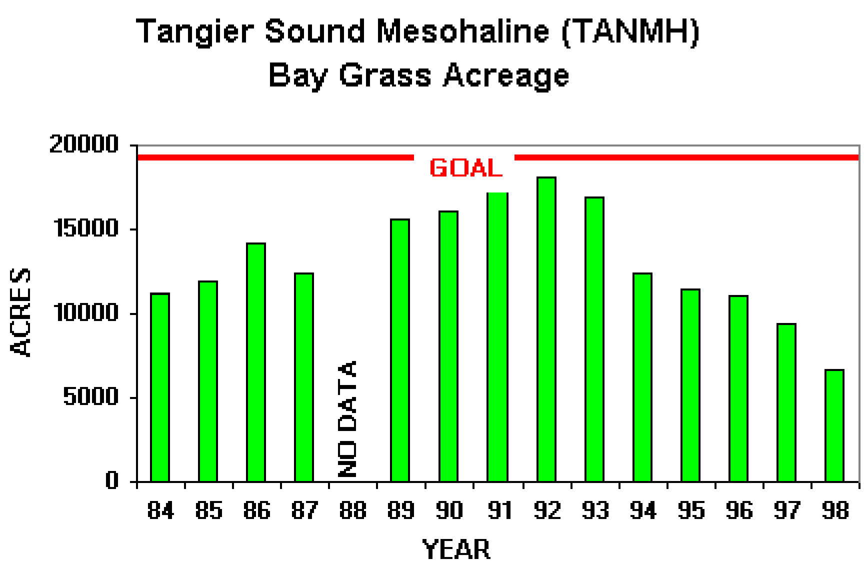


Figure 2.6: Regional Trends in Tangier Sound SAV (source: MD Department of Natural Resources, 2000).



The decline in SAV in Tangier Sound has large implications for the Chesapeake Bay. It represents a major portion of the Bay's seagrass and its continued decline represents a disturbing trend. The Md DNR writes:

> *The Tangier Sound region is of particular concern because such a large proportion of the Bay's SAV has historically existed in this area and because its SAV communities are a vital nursery ground for the blue crab and many species of fish.*

Since Bay-wide records were kept in 1984, and continuing through 1992, 25-30% of all SAV acreage in the Chesapeake Bay mainstem and all of its tidal tributaries was found in this one region, whose area is only 7% of the total for the Bay's mainstem and tidal tributaries. By 1998, the percentage of Bay-wide SAV in Tangier Sound had dropped to 10%…The loss of the historically extensive SAV beds may well have changed the local environment, further exacerbating the declines. For example, extensive fringing SAV beds can dampen wave action, thereby reducing shoreline erosion. It is therefore possible that the loss of these large beds could lead to greater erosion of local shorelines and the re-suspension of particulate matter in shallow water, thus contributing to decreases in water clarity (DNR, 2000).

The regional scale changes are linked to a number of smaller scale processes on Smith Island, especially the breaching of the marsh buffers. Figure 2.8 shows the SAV change from 1992, the recent maximum extent to 1998, the most recent year where data is available. SAV is highly variable, and the 1992 data is used to show the areas that may be covered by SAV in any given year.

Over the past 28 years, the Smith Island study areas, as defined during the reconnaissance phase and summarized in Section 1, have averaged approximately 2,500 acres of SAV, and approximately 1,800 acres in the past 8 years. Preliminary reports from 1999 and 2000 show a modest increase from the 1998 data. The 1999 drought was thought to have lowered water levels and sediment runoff from the land, thereby benefiting the SAV at a regional scale. Nonetheless, significant areas of SAV decline were identified throughout Smith Island, especially in the northern coves (Fog Point Cove, Back Cove, and Terrapin Sand Cove), and Big Thorofare. Even more alarming, the scale of SAV decline has been increasing over the past decade. Table 2.3 shows the percentage of SAV change from the thirty-year average, and Figure 2.7 shows the percentage changes in the study areas from year to year since 1990. The losses have been especially noticeable since 1994. The reasons for this decline is complicated and not well understood. Nonetheless, it is clear that after 1994 breaching and shore erosion seemed to have reached a critical stage, subjecting the SAV to increased wave energy and sedimentation.

Table 2.3: SAV Acres by Study Area

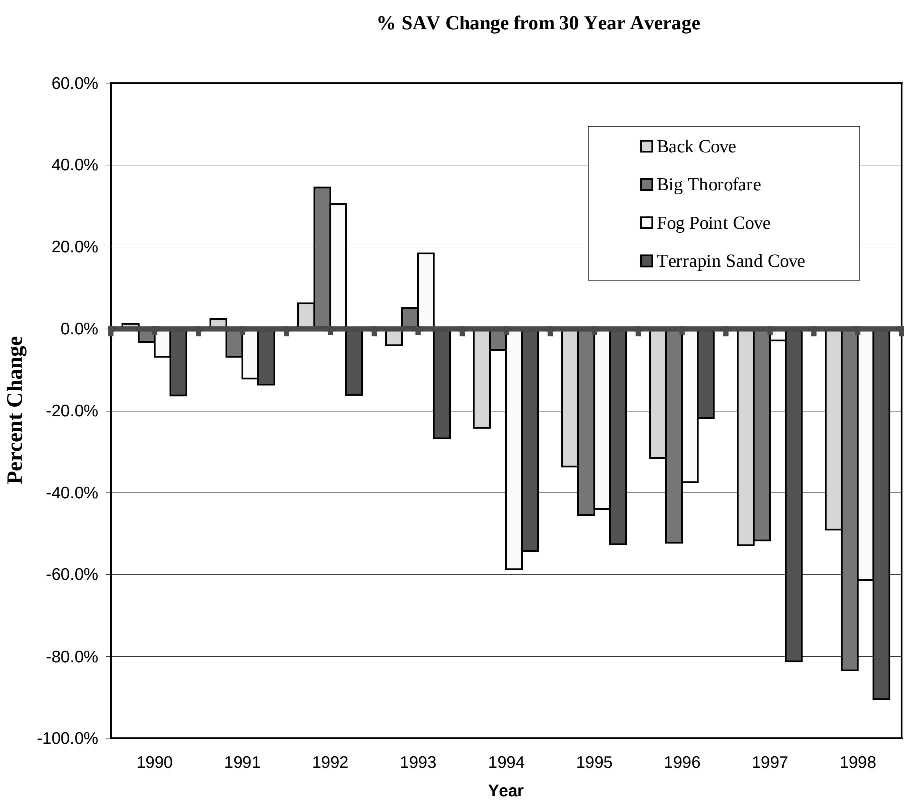
	TIER 1*	1990	1991	1992	1993	1994	1995	1996	1997	1998	Tier 2**	Average 1971-1998	% Reduction 1998 from average
Back Cove	508	469	474	492	444	351	307	317	218	236	367.6	462.9	49.0%
Big Thorofare	1604	1400	1348	1945	1519	1370	787	690	698	239	1110.7	1445.4	83.5%
Fog Point Cove	82	70	66	98	89	31	42	47	73	29	60.6	75.1	61.4%
Terrapin Sand Cove	573	401	414	402	351	219	227	375	90	46	280.6	479	90.4%
TOTAL	**2767**	**2340**	**2302**	**2937**	**2403**	**1971**	**1363**	**1429**	**1079**	**550**	**1819.3**	**2462.4**	**77.7%**

*Tier 1 represents the average from 1971-1990
**Tier 2 represents the average from 1990-1998

This pattern of SAV loss is most clearly seen in Big Thorofare, a shallow, protected area that has traditionally been excellent SAV habitat and has historically supported almost

2,000 acres. Big Thorofare is surrounded by marsh, protecting the area from wave energy. However, the marsh erosion has reached the critical stage where the Chesapeake Bay has breached through several areas of Martin National Wildlife Refuge, exposing Big Thorofare to wave energy, sedimentation, and declining water quality. Each of the coves is experiencing a similar fate, where the protecting marsh has been steadily removed. The hardest hit areas are the SAV beds immediately adjacent to the eroding marshes, where the increased sediment buries the seeds or chokes the young plants. In addition, the high nutrient content of the marsh sediment has also been found to have negative impacts on the nearby SAV.

Figure 2.7: Percentage SAV Decline by Study Area



2.2.2 Benthics

Benthic organisms are bottom dwelling organisms of aquatic ecosystems, such as snails, worms, insects, clams, shrimp, macroinvertebrates, whelks and crabs. While benthic populations have a high degree of natural population variability from year to year, many of these organisms are found in dense concentrations within the SAV beds surrounding Smith Island. Although some benthics and invertebrates are commercially valuable, the ecological significance of most invertebrate communities lies in their contributions to the food web, and make up the staple diet for larger organisms.

The most important benthic species within the Smith Island area is the blue crab (*Callinectes Sapidus*), which seeks the protection of the moderately dense SAV during the molting season. The Smith Island area is centrally located for the blue crabs annual migrations, making the SAV beds one of the most productive blue crab areas in the US. The commercial harvest of blue crabs is a major source of income for island residents. The Smith and Tangier Islands area is the most important soft-crab and peeler-crab producing areas in the Chesapeake Bay. Each acre of SAV produces an estimated 43,000 individual crabs, which is approximately 1 crab per square foot (Fredette, et. Al, 1990).

The general Smith Island/Tangier Sound area also supports other commercial shellfish operations including the harvest of oysters and clams. As with the rest of the Chesapeake Bay, the oyster diseases MSX and Dermo have decimated populations in the vicinity of Smith Island. There are nine charted oyster bars located north, west, and east of Smith Island (USDOC NOB 1961 NOB 1983). The nearest charted and presumably active oyster bar, Church Creek, is located approximately 1.5 miles west of Rhodes Point (USFWS website).

2.2.3 Avian Resources

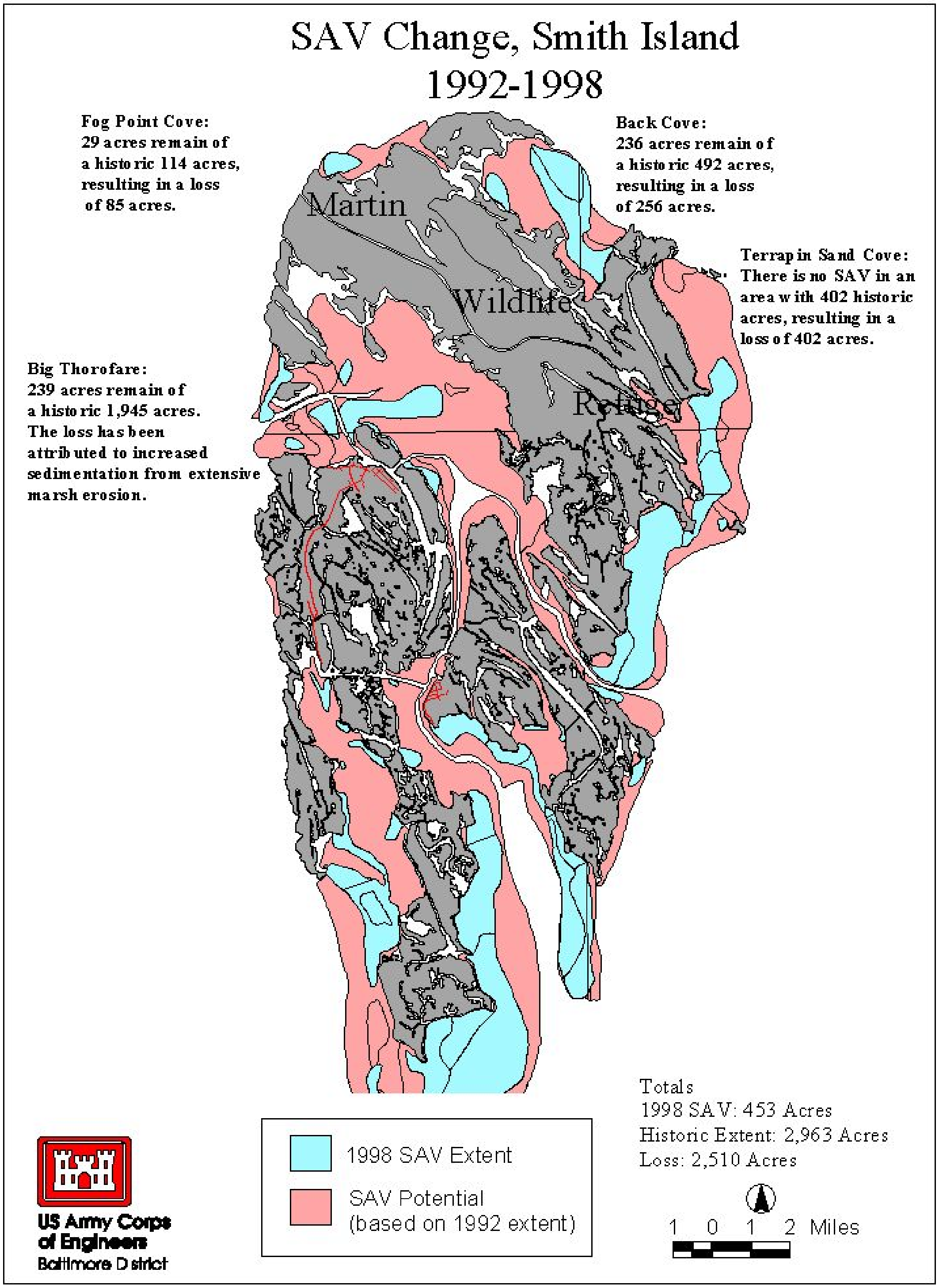
Smith Island's combination of expansive wetlands and scattered upland hammocks provide premier habitat for an incredible variety of avian species. The mix of undisturbed wetlands and scattered uplands provides an ample food supply that makes Smith Island an attractive habitat for colonial waterbirds and dozens of migratory bird species. The avian resources can generally be divided into colonial waterbirds, shorebirds, and waterfowl.

Colonial Waterbirds

Colonial wading waterbirds, distinguished by their use of long-term nesting sites, use the scattered upland hammocks as rookeries. The waterbirds nest in the uplands and feed in the nearby expanses of emergent wetlands and mudflats. Smith Island provides premier colonial waterbird habitat, providing an ample food source and protection. The following colonial waterbird species have been identified on Smith Island: glossy ibis (*Plegadis falcinellus*), great-blue heron (*Ardea herodias),* great egret (*Casmerodius albus),* snowy egret (*Egretta thula),* tricolored heron (*Hydranassa tricolor),* little blue heron (*Egretta caerulea),* cattle egret (*Bubulcus ibis),* black-crowned night-heron (*Nycticorax nycticorax),* and yellow-crowned night-heron (*Nyctanassa violacea).* Of these species, the glossy ibis, snowy egret, tricolored heron, and black-crowned night-heron are considered to be declining in number in Maryland. The little blue heron is considered rare in Maryland.

Non-wading waterbirds, terns and gulls, also utilize the marshes, dunes, and hammocks. These include: brown pelican (*Pelecanus Occidentalis),* double-crested cormorant (*Phalacrocorax auritus*), great black-backed gull (Larus marinus), herring gull (Larus argentatus), laughing gull (*Larus atricilla*), royal tern (*Sterna maxima*), sandwich tern (*Sterna sandvicensis*), common tern (*Sterna hirundo*), roseate tern (*Sterna dougalii*), Forster's tern (*Sterna forsteri*), least tern (*Sterna antillarum*), gull-billed tern (*Sterna nilotica*), and black skimmer (*Rynchops niger*). Of these species, the least tern and black skimmer are considered to be threatened in Maryland.

Figure 2.8: SAV Change on Smith Island



The loss of emergent wetlands and the associated mudflats may have adverse impacts to the colonial waterbirds. More devastating would be long-term erosion of the hammocks, damaging the existing and potential nesting areas.

Shorebirds

The following Shorebirds have also been identified on Smith Island: American oystercatcher, willet, semipalmated sandpiper, spotted sandpiper, least sandpiper, western sandpiper, purple sandpiper, pectoral sandpiper, black-bellied plover, semipalmated plover, killdeer, dunlin, red knot, lesser yellowlegs, greater yellowlegs, snipe, and sanderling.

Shorebirds rely on sandy and muddy shorelines as forage and rest sites, especially during the spring and fall migrations. These birds feed on small mollusks, worms, and crustaceans, foraging in mudflats, tidal pools, and sandy intertidal zones. The vast areas of tidal flats on Smith Island provide ideal habitat for shorebirds. Long term impacts to the mudflats associated with the Smith Island system would have adverse impacts on the shorebird populations.

Waterfowl

Smith Island combines extensive undisturbed shallow-water habitats, SAV beds, tidal mudflats, and miles of fringing low marsh. Each of these habitats provides important wintering forage for a variety of waterfowl. Collectively, they make Smith Island an important resting point for a variety of migratory waterfowl. The overall decline in waterfowl within the Chesapeake Bay reinforces the importance of Smith Island to waterfowl.

Smith Island is an important breeding area for the American black duck (*Anas rubripes*), mallard (*Anas platyrhynchos*), and gadwell (*Anas strepera*). However, numerous other waterfowl are believed to use Smith Island as a stopover point during their spring and fall migrations, including: Canadian goose (*Branta canadensis*), canvasback (*Anythya valisineria*), widgeon (*Anas Americana*), pintail (*Anas acuta*), redhead (*Aythya americana*), bufflehead (*Bucephala albeola*), black scoter (*Melanitta nigra*), oldsquaw (*Clangula hyemalis*), brant (*Branta bernicla*) and tundra swan (*Cygnus columbianus*).

Since 1956, the numbers of waterfowl including mallard, black duck, widgeon, pintail, redhead, and canvasback have been declining. The black duck has had the most significant decline. The waterfowl species decline has been attributed to regional population stresses, as well as marsh erosion and sea level rise. Significant degradation on Smith Island will continue to add to the population stresses and an important stopover during migration will continue to shrink in size, supporting fewer organisms.

2.2.4 Aquatic Resources

2.2.4.a Phytoplankton and Zooplankton. Phytoplankton and zooplankton form the base of the aquatic food web and support a variety of fish species, which help support larger species. Numerous species of phytoplankton and zooplankton are thought to inhabit the waters near and within Smith Island.

As in other areas of the Bay, Smith Island is sensitive to excess levels of nutrients (typically nitrogen and phosphorous) and summer algae blooms may damage the aquatic habitat. Algae, a type of phytoplankton, can grow in excessive numbers, exhausting the supplies of dissolved oxygen and leading to eutrophication. This results in fish kills and devastation to other aquatic life. Because of the richness of the Smith Island waters, algae blooms have the potential to be catastrophic. However, the key to preventing these blooms is bio-uptake of nutrients, which occurs in the SAV and wetlands that envelop Smith Island.

The wetlands and SAV serve as large filtering mechanisms that help prevent eutrophication in the lower Bay. The exact proportion of nutrients removed by the wetlands and seagrass is difficult to quantify. The plants use nutrients in their growing process. The roots of the plants fix nutrients that are imbedded in the substrate, giving large beds of plants more nutrient fixing potential than scattered plants. However, further decline of the SAV and wetlands is expected to diminish the nutrient uptake capacity, placing Tangier Sound in more danger of eutrophication.

2.2.4.b Fish. The marshes of Smith Island are permeated with tidal creeks, which provide spawning, nursery, and/or feeding habitat for an abundance of finfish. The contiguous waters of Chesapeake Bay and Tangier Sound also support extensive fishery stocks. Shallow waters near Smith Island are likely to support minnows, killifish, silversides, and striped bass. Species that inhabit deeper water include: menhaden, rays, bluefish, sea trout, spot, croaker, summer flounder, and drum (Lippson & Lippson, 1997).

Many of these species find extensive food source and protection in the SAV and tidal creeks that channel through the marsh. Some of these species that require wetlands and SAV include: pipefish, seahorses, sticklebacks, anchovies, silversides, shrimp, blue crabs, clams, menhaden, shad, spot, croaker, and red drum. The wetlands are especially important during juvenile lifestages, when the fish are most vulnerable to predation from larger organisms. In addition, the protection provided by the grasses makes SAV and wetlands an important spawning area. The larvae make an attractive food source for larger fish. The result is an environment that supports large fish populations, and impacts to these areas result in wide-spread impacts. Thus, SAV and wetland losses in Smith Island may have Bay-wide implications.

The area of the Chesapeake near Smith Island is known to be essential fish habitat (EFH) for a number of species: bluefish, summer flounder, king mackerel, Spanish mackerel, cobia, red drum, dusky shark, and sandbar shark. The following species also reside in the more saline areas of the Chesapeake, and are classified as having the Chesapeake as EFH: red hake, windowpane flounder, Atlantic sea herring, bluefish, Atlantic butterfish, summer flounder, scup, and black sea bass (NOAA, 1999). Many of these species are primarily found in deeper water, well offshore of Smith Island. The species of primary concern within the shallow waters near Smith Island are windowpane and summer flounder, and bluefish. These are discussed below.

Essential Fish Habitat

The Magnuson-Stevenson Fishery Conservation and Management Act requires that EFH areas be identified for each fishery management plan and that all Federal agencies consult with the National Marine Fisheries Service (NMFS) on all Federal actions that may adversely affect EFH. The EFH areas have been designated by the Fishery Management Councils and were published in March 1999 by National Oceanic and Atmospheric Administration (NOAA) and NMFS as the "Guide to Essential Fish Habitat in the Northeastern United States, Volume V: Maryland and Virginia." A Federal agency must identify the species of concern and prepare an analysis of the effects of the proposed action. The agency must also give its views regarding the effects of the proposed action and propose mitigation if applicable. The NMFS has suggested that the EFH analysis and determination be incorporated as part of the NEPA process rather than in a separate document such as a biological assessment, as is prepared for endangered species.

In the mid and northern portions of the Bay, NMFS is concerned about the populations of winter flounder (*Pseudopleuronectes americanus*) and summer flounder (*Paralichthys dentatus*). Winter flounder are predominantly found between Kent Island and Hoopers Island, though they exist throughout Maryland. In "The Chesapeake Bay in Maryland, An Atlas of Natural Resources" by Lippson, one of the spawning areas for winter flounder is Tangier Sound; however it does not show Smith Island as a spawning area. Spawning occurs in the winter (mid-February to mid-March). The eggs sink to the bottom, cling together, and do not relocate outside the spawning grounds.

Juvenile winter flounder are known to use the upper and mid-Bay. Juveniles remain in the Bay and the lower reach of tributaries in shallow water. Older fish and adults are mostly present in the mid and upper bay from November until May, and are almost absent from June until October. They prefer deeper channel waters in the summer but move into shallow water in winter to spawn. Winter flounder are mobile and have the ability to relocate during construction.

Summer flounder *(Paralichthysdentatu*s) is the only other large flatfish common to Maryland waters. Unlike the winter flounder, its migration pattern is similar to many other migrating fish species, which enter the Bay in the spring and summer and leave with the onset of winter. It is believed that the summer flounder is a winter spawner and probably seeks deep water. Since the summer flounder is not usually found in the Smith Island area during the winter, there is no reason to believe that this area is used for spawning. The summer flounder is a valuable food fish in the Bay and is caught from March until November. Summer flounder feed mainly on fish, squids, shrimp, crabs and mysis. The summer flounder prefers sandy substrate and is frequently seen near shores, partly buried in the sand. Color adaptation is developed to a very high degree.

The bluefish travels in schools, especially in deeper water, feeding predominantly on menhaden, herring, and mackerel. The fish has a voracious appetite and often pursues schools of small fish onto the beach, where bathers have been bitten by accident. The bluefish is most prevalent just off the coast during the summer. Most bluefish weigh from 2 to 15 pounds. Bluefish, especially juveniles, follow herring, menhaden, and other small fish into the middle and upper Chesapeake Bay. The waters of the Eastern Shore of

Maryland are especially important to the juveniles. There may be late summer populations of bluefish near Smith Island, although they are unlikely to be nearshore. Frequent boat activity prevents the schools from following prey near the island and bluefish are rare in the area during winter months.

2.2.4.c Commercially Important Species. The predominant commercial species in the study area are blue crabs, and shellfish such as clams and oysters. Smith Island lies within one of the most productive blue crab areas in the world. In addition, commercial fisheries for finfish such as striped bass (*Morone* saxatilis), sea trout, herring, croaker, Spanish mackerel, and summer flounder exist near Smith Island. The population of shad, black sea bass, and bluefish has fallen below commercially viable populations.

The Smith Island/Tangier Sound area has a significant recreational fishery as well. The most common species include sea trout, croaker, spot, bluefish, striped bass, and summer flounder.

2.2.5 Terrestrial Resources

2.2.5.a Mammals. The most prevalent mammalian species on Smith Island are muskrats (*Ondatra zibethica*) and small rodents such as the meadow vole (*Microtus pennsylvanicus*). River otter (*Lutra canadensis*), mink (*Mustela vison*), and red fox (*Canis vulpesalso*) occur. Each of these species are native to the expansive tidal marshes, typically feed on the marsh vegetation, and are an important part of the marsh ecosystem. No muskrat damage was observed.

Smith Island is notably free of nutria (*Myocastor coypus*), an invasive species that has caused extensive damage to other marshes on the Eastern Shore of Maryland. As a result, the marsh on Smith Island is in better health than many comparable marshes on the mainland.

2.2.5.b Reptiles and Amphibians. The diamondback terrapin (*Malaclemys terrapin*), snapping turtle (*Chelydra serpentina*), northern water snake (*Natrix sipedon*), and rough green snake (*Opheodrys aestivus*) are known to occur in the Smith Island area.

Of these species, the most vulnerable species is the diamondback terrapin (*Malaclemys terrapin*), which inhabits salt and brackish water within the tidal marshes and creeks of Smith Island. Although not endangered, the terrapin is of recreational importance and is vulnerable to over-harvesting and habitat loss. In the Chesapeake Bay, terrapins utilize multiple habitats during the course of their life cycle. In late summer, the adult diamondback terrapin generally inhabits the deep portions of creeks and tributaries, avoiding nearshore waters. Juvenile terrapins inhabit shallow creeks and coves adjacent to salt marshes as nursery areas. During June and July, female terrapins cross the intertidal zone and seek nest sites in open sandy areas, particularly in the protected coves of Martin National Wildlife Refuge. The turtles have also been observed nesting on the isolated upland hammocks of the Island complex.

Terrapin are an important resource to the watermen of Smith Island as well as an integral part of the food web on the island. Breeding sites are sandy, protected beaches that are becoming increasingly rare on Smith Island due to the degradation of the coves and the exposure of these beaches to erosive forces. Fog Point Cove, Terrapin Sand Cove, and Back Cove are considered to be extremely valuable terrapin breeding sites, containing the sandy beaches required for nesting and providing protection from wave attack and predators. Continued erosion and degradation of these coves is expected to impact the terrapin populations on Smith Island by converting the sandy beaches to less accessible marsh scarps as the coves are exposed to increased wave energy.

In addition to terrapin, three federally listed endangered turtles have been documented to visit Smith Island over the past thirty years. These include: the leatherback turtle *(Dermochelys coriacea coriace*a), hawksbill turtle *(Eretomochelys imbricata imbricat*a), and Atlantic ridley turtle *(Lepidochelys kempi*). The loggerhead turtle *(Caretta caretta carett*a) and the Atlantic green turtle *(Chelonia mydas mydas)* are considered threatened species by the federal government.

2.2.6 Water Quality

Smith Island is surrounded by brackish water (mesohaline) typical of the middle Bay ranging from 11 to 19 parts per thousand, about half the salinity of ocean. The average water temperature in the area ranges from 82.4^{o} F (27.9^{o} C) in July to 39.2^{o} F (4.0^{o} C) in February. The area of the Chesapeake Bay west of Smith Island experiences relatively little stratification and has good water clarity. Water clarity in the photic zone is required for sustained SAV growth. However, the extensive marsh erosion on the island has added considerable amounts of solids to the local area. While much of the eroded sediment may settle to the bottom or flow south, it may still affect the local water clarity. The silty marsh soils, composed of fine particles, add TSS when eroded, decreasing light availability and contributing to declining SAV beds in the area.

Three water-quality monitoring stations can be found within Smith Island waterways. The stations collect data about the inner tidal waters of the island. Seasonal trends from 1996 to 1998 indicate that water quality was good (DO >5.0 mg/l). Dissolved oxygen (DO) ranged from 5.6 mg/l in July to 11.0 mg/l in December. However, several areas around Smith Island have been temporarily closed to shellfish harvesting due to high fecal coliform levels (average >14 MPN/100ml). Shellfish closure standards are of significance because bivalves concentrate bacteria and toxins in their tissue and are subsequently consumed by people and other wildlife.

Additionally, two water-quality monitoring stations are located in the Chesapeake, in close proximity to Smith Island. These two stations are not part of the island interior waterways. A Tangier Sound station lies to the east of Smith Island, and a Chesapeake Bay main-stem station lies to the southwest of the Island. Readings from the Tangier Sound station indicate that the average yearly DO ranges from 6.3 mg/L in August to 12.1 mg/L in February. Water clarity was also recorded at that station. The average water clarity depth in 1998 ranged from 0.7 meters in August to 1.4 meters in December.

Two facilities, the Tylerton wastewater treatment plant and Rhodes Point/Ewell wastewater treatment plant, are permitted to discharge from one point into the Bay. Because of the small size of each facility, these sources do not pose a significant detrimental effect to water quality. Non-point source pollution, runoff containing concentrated nitrogen (N) and phosphorous (P) and other nutrients, leads to widespread water quality problems within the Chesapeake Bay. In general, the largest contributor of nutrients is agricultural runoff. There is currently no agriculture on the Island and the nutrient inputs most likely stem from agricultural activities along the Eastern Shore. However, the marsh and SAV serve to anchor nutrients in the substrate and filter nutrients from the water column. The filtering is working to offset the large amounts of nutrients being contributed by the agriculture of the Eastern Shore. Subsequently, nutrient levels in Smith Island waters are considered fair by the Environmental Protection Agency.

2.2.7 Uplands

Vegetative communities found on Smith Island are characterized by orache (*Atriplex patula*), seaside goldenrod (*Solidago sempivirens*), saltmarsh fleabane (*Pluchea purpurascens*), sea rocket (*Cakile edunata*), American beach grass (*Ammohila breviligulata*), and switchgrass (*Panicum virgatum*).

Additional upland habitat occurs on scattered isolated hammocks. The Smith Island ecosystem is rare because it is dominated by wetlands, with scattered upland islands within it. This is shown in Figure 2.9. Note the trees in the background, surrounded by hundreds of acres of marsh. This system provides for intensive utilization by colonial waterbirds and migratory waterfowl. The marsh/hammock system provides the necessary trees and ground cover for protection and use as a breeding area, while the marsh provides a vast amount of small fish and invertebrates for food. The result is an ecosystem that is dependent upon the small, scattered upland areas as a component of the aquatic system. The capacity of Smith Island to support significant colonial waterbird colonies is a function of having the upland breeding sites in conjunction with the wetlands and mudflats.

The remaining pockets of upland provide valuable nesting habitat for colonial waterbirds. Some of the uplands are the remains of abandoned community centers, which have since converted to bird habitat. Hammock vegetation is characterized by shrub and tree species such as wax myrtle (*Myrica cerifera*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*) and hackberry (*Celtis occidentalis*). Understory vegetation is comprised of vine species such as Japanese honeysuckle (*Lonicera japonica*), poison ivy (*Toxicodendron radicans*), and blackberry (*Ribes* sp.). The old dredged material disposal sites may be covered with dense stands of common reed (*Phragmites australis*), rather than the community described above.

Figure 2.9: Isolated hammock (in background), surrounded by tidal marsh, mudflats, and sand dunes.

Upland habitat is rare and valuable on Smith Island. Most of the remaining upland is used by the human or the colonial waterbird communities. Therefore, it is important to protect and preserve the remaining upland areas.

2.2.8 Hydrology and Hydrodynamics

2.2.8.a Wind Conditions. Smith Island is exposed to significant wind conditions, due primarily to its lack of trees or other buffering structures. In addition, the prevailing winds are from a northwesterly direction, which can intensify over the Chesapeake Bay. Wind speeds and return intervals were calculated for Smith Island and are shown in Table 2.4. The strongest winds are from the northwest.

2.2.8.b Wave Conditions. Smith Island is exposed to wind generated waves approaching from all directions. In general, the wave height and period (time in seconds for two successive crests or troughs to pass a fixed point) reaching an area are dependent on the fetch (distance over water that the wind blows for a given direction), depth of water over a given fetch, and the wind velocity and duration. Longer fetch lengths, deeper water over the fetch, higher wind velocities, and longer durations result in greater wave heights propagating into an area.

Smith Island is located in an area with a large fetch (greater than 5 miles) in almost every direction. The highest waves occur along the western shoreline, an area exposed to the currents and winds coming across the Chesapeake Bay. Wave heights and return periods are shown in Table 2.5. The most significant waves occur from the northwest, where the winds blow across the Bay and generate fetches that stretch over 20 miles. Historical SAV beds provided a buffer to the island. However, recent years have shown little SAV in the high-energy areas, exposing the marshes to the full force of the waves.

Table 2.4:Wind Speed (kts) Return Periods Adjusted for 33 ft. Elevation of Station

	RETURN PERIOD (years)				
DIRECTION	**5**	**10**	**25**	**50**	**100**
N	29.85	34.23	39.76	43.86	47.94
NNE	27.75	31.95	37.26	41.2	45.1
NE	25.51	29.16	33.78	37.21	40.61
ENE	26.13	30.57	36.19	40.36	44.50
E	26.92	31.90	38.19	42.86	47.49
ESE	31.35	38.10	46.63	52.96	59.24
SE	27.27	31.44	36.71	40.62	44.50
SSE	27.14	30.84	35.51	38.97	42.41
S	24.96	27.69	31.14	33.70	36.67
SSW	24.39	26.65	29.51	31.63	33.73
SW	28.56	31.72	35.71	38.67	41.61
SW	28.56	31.72	35.71	38.67	41.61
WSW	32.68	38.28	45.35	50.60	55.81
W	29.19	32.12	35.83	38.58	41.31
WNW	34.65	38.76	43.95	47.80	51.62
NW	40.03	46.82	55.37	61.71	68.00
NNW	35.10	40.60	47.54	52.68	57.79

Table 2.5: Wave Heights and Return Periods

		OFFSHORE WAVE HEIGHTS (ft.)				
AREA	**DIRECTION**	**5-YEAR**	**10-YEAR**	**25-YEAR**	**50-YEAR**	**100-YEAR**
NORTHWEST	NW	5.7	6.6	7.7	8.5	9.3
RHODES POINT	NW	5.7	6.6	7.7	8.5	9.3
TYLERTON	S	4.3	4.8	5.3	5.7	6.1
NORTHEAST 1	SSE	3	3.3	3.7	4	4.2
NORTHEAST 2	ESE	2.2	2.7	3.3	3.8	4.2
NORTH 1	NW	5.7	6.6	7.7	8.4	9.2

2.2.8.c Tidal Currents. The magnitude of the tide and the tidal currents heavily influence Smith Island. Nearly all of the island is tidal marsh, heavily dependent upon regular inundation by high tides. Higher tides allow the waves generated along the various fetches to propagate closer to shore before breaking. If the tide elevation is great enough, large portions of the island can be inundated allowing direct wave attack on interior portions of the island. Table 2.6 indicates the tidal elevations in the study area for the various return periods.

2.2.8.d Sedimentation and Erosion. Smith Island is currently threatened by severe shoreline erosion, especially along the western shoreline, where between 8 and 10 feet of shore is eroding per year. The erosion is severely effecting the tidal marsh and is discussed in Section 2.2.1.

Table 2.6: Tidal Elevations and Return Intervals

RETURN INTERVAL	ELEVATION (ft MLLW*)
Mean Tide[1]	1.6
Spring Tide[1]	1.9
5 year[2]	4.2
10 year[2]	4.6
25 year[2]	5.1
50 year[2]	5.5
100 year[2]	5.8

*Mean Lower Low Water

[1] U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), Tide Tables, High and Low Water Predictions, East Coast of North and South America, 1997.

[2] Virginia Institute of Marine Science, Storm Surge Height-Frequency Analyses and Model Prediction for the Chesapeake Bay, 1978.

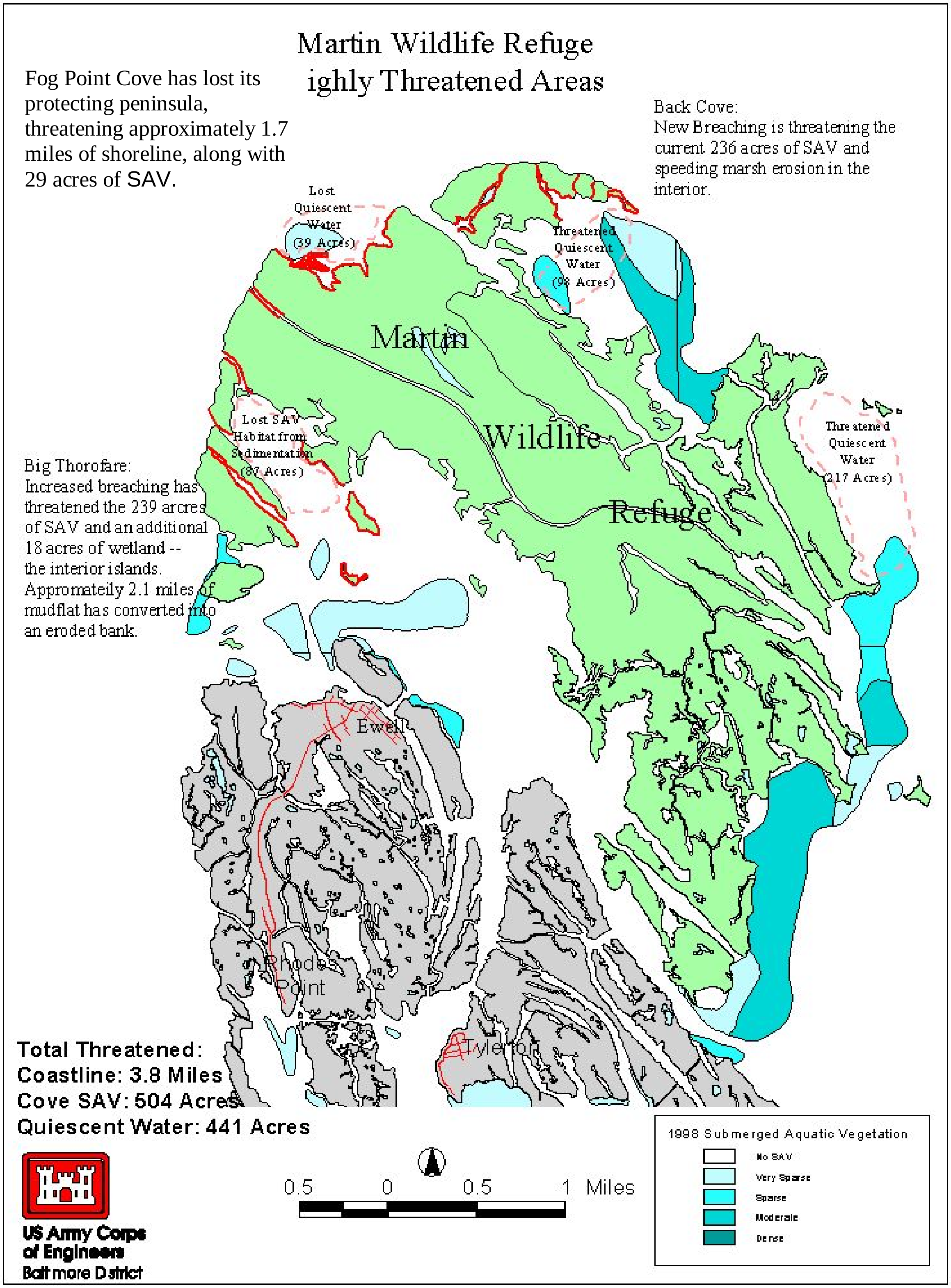
The erosion is having a secondary effect by drastically altering the area's hydrologic connection. Tidal breaches are eroding through the marsh along the western shoreline and the northern coves, exposing the protected interior marshes, tidal guts, and coves to increased sediment loads, wave energy, and tidal currents. The result is that many protected areas of Smith Island will become threatened over the next several years. Because erosion and breaching are hard to predict, it is difficult to determine which areas will be substantially altered. However, Figure 2.10 shows many of the threatened areas, based on current trends. Table 2.7 highlights the amounts of resources threatened by continued erosion over the next 25 years.

Table 2.7: Resources Threatened by Continued Erosion

Resource	Threatened Over Next 25 Years
Threatened Wetlands	174.5 Acres
Threatened Coastline	3.8 Miles
Threatened Islands (interior)	12.8 Acres (one 3 acre island, one 9.8 acre island)
Threatened SAV	504 Acres
Threatened Quiescent Water	441 Acres

Smith Island is also facing heavy pressure from land subsidence and sea level rise (with a combined rate of approximately 3.9 mm per year), resulting in a severe loss of landmass over the past few centuries. Although marshes accrete over time, through the development of peat layers, the islands in the Tangier Sound area have not been able to keep pace with sea level rise in the Bay. While sea level rise is a global phenomenon, landmasses in the Bay are more susceptible to slight changes because of land subsidence, the causes of which are still poorly understood. Nevertheless, Smith Island has failed to keep pace. Thousands of years ago, Smith Island was part of a peninsula that encompassed Tangier Island to the south, South Marsh and Bloodsworth Islands to the north, and formed the western shoreline of the Nanticoke River. Over time, as the water level rose and erosion continued, the peninsula separated into distinct islands. The land itself has steadily changed from dry inhabitable uplands to wetlands. Smith Island is almost all salt marsh and has lost considerable amounts of upland habitat, resulting in the loss of the farms that were the primary means of subsistence on the island centuries ago.

Figure 2.10: Areas Threatened by Continued Erosion



The three towns now use most of the available upland area. Similarly, the historic wetlands have been lost entirely to open water, and much of the wetlands that had been converted to wetlands over time have also been lost to inundation and erosion. Historically, Smith Island has lost thousands of acres of wetlands and thousands of acres of upland have converted to wetlands.

The average elevation of the island is 2 feet (.61m) above mean sea level (MSL) and the maximum elevation is about 5 feet (1.5m) above mean sea level. The range of tide is about 1.6 feet. Sea level is rising at a rate of 3.3mm yr^{-1} in the Chesapeake Bay region. Even without the occurrence of erosion, it is predicted that the island will be underwater in approximately 400 years.

2.3 CULTURAL RESOURCES

No comprehensive archeological survey of Smith Island has been conducted. However, several meetings with the staff of the Maryland Historic Trust (MHT) were conducted, and limited documentary research and field investigations, have indicated the potential for historic and prehistoric archeological resources to exist within the upland areas Smith Island. There are probably a number of properties associated with former settlements which the State Historic Preservation Officer (SHPO) may deem important. However, there are no sites listed on, or eligible for, the National Register of Historic Places (NRHP). There are no existing settlements within Martin Wildlife Refuge, although the refuge supported a number of households throughout the islands 400 year inhabitation. Because much of the area was formerly upland, the island supported some farming and grazing, resulting in a different land use pattern. However, the household sites are known to be inland of the current shoreline, located near the existing hammocks—many of which may be the remnants of former settlements.

Because the project will impact no upland sites and is being built in existing shallow water, no impacts to archaeological sites are expected. There are no known submerged archeological resources in the project area. Along the western shoreline, there are no historic structures. The upland areas may contain traces of old island settlements; however, existing upland will not be impacted by the project.

Underwater archaeology sites are not expected, the project will alter existing open water area that was formerly fastland connected to the island. Historical evidence suggests that the area may have been used for farming or grazing during early occupation. However, known archaeological evidence of this occupation has not been documented. A review of historical data indicates that early settlements and houses were not located within the project footprint, and were located inland of the impacted area. As a result, no impacts to submerged or inland archaeological sites are expected.

2.4 SOCIO-ECONOMIC RESOURCES

2.4.1 Land and Water Use

The Smith Island residents rely on the water for their transportation, income, and, in some cases, subsistence. Because almost all of Smith Island is marsh, settlement is concentrated on the three towns that inhabit the large pockets (over 20 acres) of upland. The three towns are home to a culturally distinct population of watermen, many of whom are descendents of the island's original settlers from the mid 1600s. The three towns are accessible only by boat and regular ferry service that runs between the island and Crisfield, Maryland. Although small country stores serve the island, most stores and services are located in Crisfield, making boats integral to island life. Island children, after elementary school, are boated to Crisfield for school. The towns are almost entirely dependent upon the crabbing industry and are some of the few remaining communities of watermen on the Chesapeake. Almost all economic activity stems directly from the resources of the Chesapeake Bay and boats are more common and more important than cars. The watermen are a fiercely independent and devoutly religious people who cherish the traditions and seclusion of their island setting. The island contains no useable farmland. The towns are ringed by vast stretches of tidal marsh, with the few hammocks visible in the distance.

Most islanders are adept at operating waterborne vessels to navigate between the three communities on the island. Nearly all of the residents of Smith Island are dependent on the seafood industry for their livelihood. Seafood is harvested in nearby waters and either processed locally or packed for shipment. There is a crab-picking cooperative located in Tylerton that processes crabmeat for commercial shipment or local consumption by the families participating in the cooperative. While there is no other significant industry on the island, there is a museum, restaurant, and gift shop in Ewell, which cater to the seasonal tourists disembarking from tour boats from May to October. Ewell is becoming a popular tourist destination with approximately 40,000 tourists visiting each year (based on conversations with tour boat owners and island residents) who are drawn by the island's natural beauty and quiet charm. The recent addition of a highly successful commercial bed and breakfast in Tylerton has resulted in an increase in tourist visits to Tylerton, which is on a separate island from Ewell and Rhodes Point.

2.4.2 Population

Although exact historic population statistics for Smith Island are unavailable, anecdotal information indicates that the population peaked at about 800 residents early in the twentieth century. By 1960, the population had declined to about 650 residents. By 1990, according to the census of that year, the Smith Island population had declined to 459 residents. The 1990 census counted 238 residents in Ewell, 124 residents in Tylerton, and 97 residents in Rhodes Point. The downward spiral in population on Smith Island contrasts with an upturn in the Somerset County population. Between 1980 and 1990 the population of Somerset County increased by 22 percent. In the same timeframe, the state of Maryland population increased by 9.9 percent.

Population estimates from the 1990 census as well as long-term population projections are shown in Table 2.8. State of Maryland projections listed for years 2010 and 2020 were interpolated from census projections for mid-decade years (i.e., 2005, 2015). Long-term state projections to 2050 were extrapolated at the same rate of increase as predicted for 1990 to 2020. Projections for Somerset County through 2020 were obtained from 1996 projections by the Maryland Office of Planning, and were extrapolated from 2020 to 2050 based on the long-term trend. Long-term population projections were not available for Smith Island. However, there has been an average decline of about 10 percent per decade from 1960 to 1990. Projecting this rate of decline over the period of analysis results in the population figures presented in the table for Smith Island. The resulting estimates may be conservative because according to a 1995 survey by the Somerset County Sanitary District, the estimated population on Smith Island was 400 residents, a 12.8 percent decline since the 1990 census. Assuming a continuation of a decline at that recent 5-year rate, total population on the island would likely fall to less than 200 residents by 2030.

Table 2.8: 1990 Population and Population Projections

	Census	Population Projections					
	1990	2000	2010	2020	2030	2040	2050
USA	248,709,873	274,634,000	297,716,000	322,742,000	346,899,000	369,980,000	393,931,000
Maryland	4,797,556	5,275,000	5,665,000	6,068,000	6,500,000	6,962,000	7,674,000
Somerset County	23,440	25,400	26,850	27,250	28,700	30,100	31,600
Smith Island*	459	413	372	335	302	272	245

Source: U.S. Department of Commerce, Census Bureau.

*Note: Population estimates are based on a continuation of the 1960-1990 average decline of 10 percent per decade.

Possible explanations for the continuing decline in population may be revealed by a view of study area age and gender population distributions. The distributions of these characteristics on Smith Island differ markedly from national and state level distributions. Table 2.9 presents the 1990 age distributions at the national, state, county and Smith Island levels. Age distributions on Smith Island are consistent with the state of Maryland and Somerset County distributions, except in the 0-4 and the 25-64 age ranges. In 1990, there were no children counted in the 0-4 age group on Smith Island. This anomaly probably reflects the trend toward migration of younger adult residents to the mainland. In the 25-64 age group, the Smith Island population significantly exceeds that for the nation, state, and county. Gender distribution data reported in the 1990 census of population and housing are shown in Table 2.10.

The Smith Island gender distributions differ considerably from the national, state and county distributions. Fifty eight percent of Smith Islanders in 1990 were male, 9 percent greater than the state and national figures and 5 percent more than in Somerset County.

This significant gender disparity is another possible factor in the overall population decline because there are relatively few women of childbearing age living on the island.

Table 2.9: Age Distribution

	Age (years)	1990 Census Population	%
USA	0 to 4	18,264,096	7%
	5 to 17	45,342,448	18%
	18 to 24	26,234,893	11%
	25 to 64	127,673,161	51%
	over 65	31,195,275	13%
Maryland	0 to 4	368,494	8%
	5 to 17	810,222	17%
	18 to 24	504,543	10%
	25 to 64	2,596,388	54%
	over 65	517,909	11%
Somerset County	0 to 4	1662	5%
	5 to 17	3625	15%
	18 to 24	2711	12%
	25 to 64	11,951	53%
	over 65	3491	15%
Smith Island	0 to 4	0	0%
	5 to 17	73	16%
	18 to 24	51	11%
	25 to 64	278	61%
	over 65	57	12%

Source: U.S. Department of Commerce, Census Bureau

In 1990, according to census data, there were 55 females in the expected childbearing age range living on the island, compared with 113 men in the expected paternal age range. This gender disparity was identified as a concern by local residents at a Corps of Engineers public meeting on the island for reproduction reasons and as a factor in young men leaving the island, see Section 8.

Another trend apparent on Smith Island is that people who are not year-round residents of the island are purchasing residential properties to use as vacation housing. If year-round population on the Island continues to decline and more housing becomes available, this trend could impact the Island’s social and economic profile by transplanting the historic waterman culture with a more wealthy, vacation or leisure-oriented society.

Table 2.10: Gender Distribution

		1990 Census Population	%
USA	Male	121,172,379	49%
	Female	127,537,494	51%
MD	Male	2,327,097	49%
	Female	2,470,459	51%
Somerset County	Male	12,323	53%
	Female	11,117	47%
Smith Island	Male	265	58%
	Female	194	42%

Source: U.S. Department of Commerce, Census Bureau

2.4.3 Income, Employment and Industry

Per capita income and poverty data as reported in the 1990 census are presented in Table 2.11. The table shows that per capita income in Somerset County and on Smith Island falls below the national average. Per capita income in Somerset County is 29 percent below the national average and 43 percent below the state level, while 1990 income levels on Smith Island trailed the national level by 26 percent and the state level by 40 percent. Also, the proportion of families below the poverty level in Somerset County exceeds the national average.

According to 1990 census information, there were 98 persons, or 21 percent of the total Smith Island population, identified as having incomes below the poverty level (data is unavailable by family). Of a total of 165 households on Smith Island, there were 40 reported incomes of less than $10,000 in the 1990 census. Although these monetary income data appear to present a bleak economic picture, the profile they represent is incomplete. Because of the high degree of community cohesion and cooperation on Smith Island, and the partial subsistence provided by the consumption of seafood harvested by Smith Island watermen, the quality of life of the Island's residents is probably not comparable to that of low-income residents in urban centers. While Smith Islanders live modestly, they also appear to live comfortably. As one islander said, "No one has ever gotten rich on Smith Island, but I don't think anyone has ever starved either."

Table 2.11: Per Capita Income (1990)

	Income ($)	Families Below Poverty Level (%)
USA	14,420	10.0%
Maryland	17,730	6.0%
Somerset County	10,232	12.2%
Smith Island	10,698	Data Unavailable

Source: U.S. Department of Commerce, Census Bureau.

Projections of per capita income through 2045 are shown in Table 2.12. The Bureau of Economic Analysis was the source for national data, while the Maryland Office of Planning provided income data through 2020 for Maryland and Somerset County. Income levels for 2025 and 2045 for Maryland and Somerset County were extrapolated from Maryland Office of Planning data. Income levels in the State of Maryland are expected to exceed the national average over the period of analysis, and income in Somerset County is expected to lag significantly below the national average and the state average. Although no location specific per capita income projections were available for Smith Island, it is expected to remain parallel to the Somerset County average.

Table 2.12: Projected Per Capita Income

	Per Capita Income Projections ($1987)					
	2000	2005	2010	2015	2025	2045
USA	$17,718	$18,752	$19,695	$20,517	$22,003	$25,157
Maryland	$20,382	$21,443	$22,403	$23,118	$24,200	$26,400
(difference from national level)	15%	14%	14%	13%	9%	5%
Somerset County	$12,001	$12,762	$13,438	$13,771	$14,355	$15,600
(difference from national level)	-32%	-32%	-32%	-33%	-35%	-38%

Source: U.S. Department of Commerce, Bureau of Economic Analysis

According to the 1990 census, the national labor force (persons age 16 and over) has grown by 18 percent since 1980. Labor forces in Maryland and Somerset County have increased 8 and 2.8 percent, respectively, since 1980. The total 1990 labor force and employment distributions by market sector are shown in Table 2.13. The 1995 unemployment rate in Somerset County was reported at 9.1 percent, according to Maryland Office of Planning data.

As of 1995, there were 377 businesses in Somerset County, 4 of which had 100 or more employees. Crisfield and Princess Anne are the major business and industrial centers in the County. Somerset County is a major seafood producer in the mid-Atlantic region. Bushels of crabs harvested by the Smith Island watermen are sold to seafood distributors in Crisfield. Crabs processed at the seafood cooperative in Tylerton on Smith Island are shipped to market in Delaware. Agriculture is also an important economic linchpin in the Somerset County economy. Corn and soybeans are the major cash crops produced on County farms. There are no cash crops raised on Smith Island.

2.4.4 Education

Because of the declining number of children of school age on Smith Island, there are currently no operating public schools beyond elementary school. There is a school building in Tylerton, formerly used as an elementary school. Children of elementary school age in Tylerton, as well as Ewell and Rhodes Point, now commute to Ewell to attend elementary school. Middle school and high school children commute by boat to Crisfield. According to the 1990 census, there were 96 Smith Island children enrolled in public schools.

Table 2.13: Employment by Sector

	Population >Age 16	Agriculture & Mining	Construction	Manufacturing	Transportation &Utilities	Wholesale & Retail Trade	Personal & Professional Services	Gov't
USA	115,681,202	3,838,795 3%	7,214,763 6%	20,462,087 18%	8,205,062 7%	24,556,692 21%	45,865,735 40%	5,538,077 5%
MD	3,736,850	25,800 2%	195,500 7%	212,900 8%	118,200 4%	593,100 22%	1,061,000 39%	508,000 19%
Somerset County	19,200	700 8%	600 7%	800 9%	300 3%	1,600 17%	1,900 21%	2,500 27%

Source U.S. Department of Commerce, Census Bureau.

Since 1980, the Chesapeake Bay Foundation has administered an educational program based in Tylerton. Centers of higher education on the Delmarva Peninsula include the University of Maryland Eastern Shore (UMES) and Salisbury State University in Salisbury. Located in the town of Princess Anne, UMES offers undergraduate and graduate programs, including doctoral programs in marine, estuarine, and environmental sciences. In addition, Wicomico Community College offers a "college without walls" program on the lower Eastern Shore of the peninsula. According to the 1990 census 78 percent of those persons 25 years and older have obtained a high school diploma in the state of Maryland, while in Somerset County and Smith Island the proportions are lower, 61 percent and 24 percent, respectively. The 1990 census also reports that among persons 25 years and older, 27 percent have obtained a bachelor's or professional degree in the State of Maryland, while in Somerset County and Smith Island the proportions are lower, 10 percent and 1 percent, respectively.

2.4.5 Transportation

As noted earlier, access to the mainland from Smith Island is limited to waterborne vessels. While most residents have at least one boat, there are also a number of private ferries that make daily trips to Crisfield, which takes approximately 45 minutes each way. A schoolboat takes the children to school in Crisfield each morning, and carries mail and supplies for Smith Island residents. On Smith Island, the residents use a combination of automobiles, golf carts, and bicycles.

Once on the mainland, U.S. Route 13 and Maryland State Highway 413 provide access to major interstate routes. The Norfolk/Hampton Roads metropolitan area is 95 miles south, the highway distance to Baltimore, Maryland is 119 miles, and to Washington, D.C. is 133 miles. There are no aircraft landing facilities on Smith Island. The existing transportation network makes Smith Island one of the most difficult areas in Maryland to access from the Washington/Baltimore metropolitan area.

2.5 RECREATION AND TOURISM

Recreation opportunities on Smith Island are shaped by its history, its location in the Bay, and its environmental resources. The Island's unique culture and relative isolation continue to be strong influences on the recreation activities of its residents. When not actually crabbing, oystering, or fishing, watermen and their families spend considerable time maintaining and preparing their boats and equipment. These tasks, such as making crab pots, require time and care that might otherwise be invested in more recreational crafts, such as woodworking and carving wooden decoys. Bicycle riding is a popular form of recreation as well as a practical way to get around on the narrow lanes of the island. Island residents report that gardening and raising the rose bushes common in earlier times has been more difficult as the land has become wetter.

Group recreation activities on the Island are focused around family, community, church, and school. Each town has a small complement of recreation facilities: a church and fire hall to provide space for club meetings, dinners, and similar organized indoor recreation activities; a ball field; and school playground. The community center at Rhodes Point is used for a variety of formal and informal meetings. It is used because of its central location to all three towns on the Island.

Approximately 40,000 tourists visit Smith Island each year (based on conversations with tour boat owners and island residents), drawn by its natural beauty and quiet charm. Ewell is the primary tourist destination and facilities include a market, restaurant, bed and breakfast, and an inn. The recent addition of a highly successful commercial bed and breakfast in Tylerton has resulted in an increase in tourist visits to the town, which is on a separate island from Ewell, the primary tourist destination, and Rhodes Point.

2.6 RARE, THREATENED AND ENDANGERED SPECIES

The USFWS and MdDNR acknowledge Smith Island as potential habitat for several threatened and endangered species. The federally threatened and endangered species known to visit Smith Island are listed in Table 2.14. In addition, the northern harrier (*Circus cyaneus*), a state rare species, and the Black Skimmer (*Rynchops niger*), a state threatened species, occur on the Island. These species predominately use the isolated hammocks within the interior of the marsh. The threatened and endangered turtles are known to use the interior mudflats and tidal guts upon occasion. These instances are rare and the sightings are transient individuals, rather than resident populations. There are no permanent populations of any of the state or federally listed species within the project area. The project area lies outside of the disturbance area of the nesting northern harrier.

2.7 PRIME AND UNIQUE FARMLAND

There is no farming on Smith Island and, therefore, no designated prime and unique farmlands. The existing upland is used for the towns, and is surrounded by unbroken expanses of tidal marsh. Farming has not occurred for decades, as a result of erosion and saltwater intrusion.

Table 2.14: Federally Listed Threatened and Endangered Species Known to Visit Smith Island

Species	Status
bald eagle *(Haliaeetus leucocephalus leucocephalu*s)	Threatened
red-cockaded woodpecker *(Picoides boreali*s)	Endangered
shortnose sturgeon *(Acipenser brevirostrum*	Endangered
leatherback turtle *(Dermochelys coriacea coriace*a)	Endangered
hawksbill turtle *(Eretomochelys imbricata imbricat*a)	Endangered
Atlantic Ridley turtle *(Lepidochelys kemp*i)	Endangered
loggerhead turtle *(Caretta caretta carett*a)	Threatened
Atlantic green turtle *(Chelonia mydas mydas*	Threatened

2.8 HAZARDOUS, TOXIC AND RADIOACTIVE SUBSTANCES

The Smith Island area of the Chesapeake Bay was evaluated for hazardous, toxic and radioactive wastes (HTRW) using the U.S. Environmental Protection Agency's (EPA) Toxic Release Information System (TRI) and Resource Conservation Recovery Information (RCRIS) databases, as well as the Comprehensive Environmental Response, Compensations, and Liability Information System (CERCLIS) and National Priority List (NPL). No HTRW sites were found on or surrounding Smith Island.

2.9 AIR QUALITY

Air quality is determined by measuring the ambient pollutant concentrations of particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and ozone, and comparing the concentration to the corresponding standards as determined by the EPA. Maryland is divided into six air quality control areas. Smith Island lies within the Eastern Shore control area. The entire state of Maryland has attained its air quality goals for all pollutants except ozone. Only the Baltimore, Washington D.C, and Cecil County areas are not in attainment for ozone. The other areas of Maryland have attainment status for all identified pollutants. Smith Island, as part of the Eastern Shore control area, has achieved all of its air quality goals (See MDE website for more details).

According to a query of the Aerometric Information Retrieval System (AIRS), there are no facilities discharging into the air from Tylerton. However, there are two facilities located at Ewell, outside of the project areas that are authorized to discharge.

2.10 NOISE

Smith Island is not developed in the low tidal marshlands and is populated only on the remaining uplands, which make up only a small portion of the island. Noise occurs in the area as a result of both recreational boating and commercial fisheries (crabbing) activities. In addition, wading birds produce a substantial volume of noise at rookery sites. Noise is also produced by the numerous motor boats used by the islanders. In general, the Island is extremely quiet, making it a popular tourist destination and residence. Despite the decline in year-round population, there has been an increase in part-time and summer residents, many of whom seek the solitude of Smith Island life.

2.11 EXISTING CONDITIONS WITHIN THE STUDY AREAS

The study areas identified during the reconnaissance phase were reconsidered during the feasibility phase. Due to the extensive coordination during the reconnaissance phase, the study team and the sponsors agreed to a feasibility-level scope of work that focused on these areas: Western Shoreline/Big Thorofare; Fog Point Cove; Back Cove; Terrapin Sand Cove; Rhodes Point; and Tylerton. Rhodes Point and Tylerton were broken off of the feasibility study and are not considered for implementation in this report; however, since much of the technical information for the Rhodes Point and Tylerton plans was gathered during this study effort, some of the information is presented here. The following discussions provide some specific detail about each recommendation site in addition to the previous island-wide information presented earlier in this section.

2.11.1 Western Shoreline/Big Thorofare

The Western Shoreline of the Wildlife Refuge extends from approximately Swan Island on the south to Fog Point on the north. This is a linear distance of approximately 9,840 feet, a length of 1.86 miles. The Western Shoreline provides a buffer from the open waters of the Chesapeake Bay to the interior waters of Big Thorofare. Under existing conditions, the Western Shoreline is eroding at a rate of 10 to 12 feet per year, resulting in 2.7 acres of lost wetlands per year. Weak points along the shoreline are susceptible to breaching. Breaching of the shoreline threatens existing SAV beds and the potential for restoration of lost SAV habitat in Big Thorofare. Breaching has already occurred in some areas and threatens in several other points along the shoreline. Within Big Thorofare, there are 239 acres of SAV remaining from a 1992 peak of 1,945 acres. Big Thorofare has averaged approximately 1,445 acres of SAV over the past two decades, although the SAV acreage has not been above 1,000 acres since 1995. Continued breaching will undermine much of the remaining SAV. There is also 2.1 miles of mud-flat shoreline and 87 acres of quiescent shallow water habit in Big Thorofare protected by the Western Shoreline that could be impacted with continued erosion and breaching of the shoreline.

2.11.2 Fog Point Cove

Fog Point Cove extends from Fog Point at the northwest corner of the island to Bards Point on the east. There are about 1.5 miles of shoreline along Fog Point Cove. Under existing conditions, the shoreline at Fog Point is eroding at a rate of 10 ft. per year, resulting in 1.09 acres of marsh lost per year. The erosion has caused a gradual loss of the peninsula at Fog Point, which will expose the cove to increased wave action and sedimentation, damaging SAV beds within the cove.

Approximately 29 acres of SAV remain of an historic peak of 114 acres of SAV in the cove. There are also 1.7 miles of mud flats shoreline and 56 acres of quiescent shallow water habitat protected within Fog Point Cove that could be impacted with continued erosion of the shoreline. Historically, Fog Point Cove was known to have more diamondback terrapin nesting sites than any other stretch of shoreline on Smith Island (Harrison, Personal Communication, 2000). These sites are likely to be impacted by the increased exposure of the cove.

2.11.3 Back Cove

Back Cove is comprised of about 6 miles of shoreline extending from Bridge Creek on the west to approximately Otter Creek on the east. The rate of erosion of shoreline at Back Cove is 8 feet per year, resulting in approximately 1.54 acres lost per year along both shorelines. Breaching threatens the northwest peninsula, which has increased sedimentation and added wave energy to the cove. The peninsula is steadily eroding away, further exposing the cove. There are 236 remaining acres of an historical peak of 492 acres of SAV habitat protected by the shoreline of Back Cove. In addition there are about 55 acres of emergent wetlands, 1 acre of mudflats and 98 acres of quiescent shallow water habitat along the Back Cove shoreline.

2.11.4 Terrapin Sand Cove

Terrapin Sand Cove extends from Otter Creek on the north to approximately Joes Ridge Creek on the south. Most of the shoreline that forms the cove is already eroded away. There was no remaining SAV within Terrapin Sand Cove when surveyed in 1998, dramatically reduced from an historical peak of 402 acres in 1992. There are 217 acres of quiescent shallow water habitat in the cove that may be applicable for SAV restoration.

2.12 SUMMARY AND CONCLUSIONS

No habitat on Smith Island functions independently. Rather, Smith Island is more accurately thought of as an independent and rare ecosystem, working in concert to support an exceptional number of wildlife species. Smith Island is a convergence of the shallow waters of the Bay, SAV, and mudflats, followed by low and high marsh, and dotted with upland shrubs and trees. Smith Island is a system that joins the resources of the Bay with the resources of the tidal marshes, allowing wildlife to move between these areas in search of food, breeding areas, nesting sites, and protection. The mudflats, the interface between the land and sea, provide a daily supply of worms and clams for the numerous birds nesting on the isolated hammocks. The SAV buffers the marsh from the pounding waves, protects and feeds the crabs, seahorses, and fish, which then feed the shorebirds nesting within the wetlands. The emergent grasses hold the island together, providing food and cover at the same time. Together, each habitat area works in concert with the others to form an important and diverse system.

Perhaps equally as importantly is the fact that Smith Island is isolated from the millions of people living within the Bay watershed. Smith Island represents one of the most isolated places within the Maryland portion of the Bay. In Martin National Wildlife Refuge, even that presence is not felt and the wildlife has free range over thousands of acres.

Finally, despite its exceptional value, the Smith Island system is also highly threatened. Smith Island represents a unique habitat that is facing both short-term and long-term threats to its sustainability and functions. The largest threats are continued erosion, marsh breaching, increased levels of TSS, excessive nutrient levels, and sea level rise. While sea level rise is a Bay-wide problem, it is beyond the scope of local action. Regardless, a healthy marsh can accrete, allowing it to maintain itself despite the rising seas. On Smith Island, the local processes (erosion, SAV loss, increased breaching), are more important. If unchecked, it is the local process that will damage the precarious balance of the ecosystem, and in the long run, make the marsh more vulnerable to, and less able to recover from, the effects of sea level rise due to other climate and anthropogenically-induced degradation.

At present, Smith Island is losing nearly 7 acres of marsh per year in the study areas alone. Overall erosion is likely to be considerably higher. Smith Island has also lost over 2000 acres of SAV in the past decade. As it loses its SAV buffer, its exposure will increase to the elements of the Bay. Smith Island is one of the most pristine island groups in the Chesapeake Bay watershed. Given its steady degradation, the Bay is in danger of losing an exceptional ecosystem.

Section 3

PROBLEMS, NEEDS AND OPPORTUNITIES

3.1 PROBLEM IDENTIFICATION

The natural process of erosion, in conjunction with human activities, has degraded, threatened, or eliminated many islands in Chesapeake Bay, and has reduced the size of Smith Island by approximately 30-percent over the last 150 years. Thousands of acres of marsh have eroded into the Bay, contributing sediment and nutrients and causing a loss of critical wetland functions. SAV coverage declined during the 1990s, continuing a trend that has been tracked to the 1930s. Historical coverage prior to the 1930s has been estimated anecdotally. Except for a period of recovery during the 1980s when many policies to improve water quality were implemented, the trend has been consistent. Research shows that, although SAV populations are affected by many factors, the localized effect of erosion on water clarity can be over-riding. As reported by Dr. Koch (Appendix A), the continued erosion of Smith Island's marshland is contributing to the decline in SAV coverage. Furthermore, the reduced amount of SAV means that the wave attenuating properties of the SAV beds are lost and this causes yet more erosion.

Erosion also threatens populated areas, especially in Tylerton, where the road and utilities are in imminent danger. The sediment from eroding shorelines frequently settles out in deeper water where the water energy is less, such as in navigation channels. This was found to be a serious problem in Sheep Pen Gut near Rhodes Point.

This section identifies problems in the study area that could be aided by implementation of a Smith Island project by USACE.

3.1.1 Reconnaissance Efforts

The reconnaissance study began in June 1996. Early study efforts included an exhaustive search for public and agency input. The study team visited Smith Island several times within the first few months of the study, conducted meetings in each of the three towns, held an island-wide community meeting, and interviewed individual citizens who were identified as having important or special interests for input. The team presented the study to various interested groups and individuals to gather historical information and opinions as to what problems existed. The first product was a list of problems, some that the USACE had authority to address, and many that were not in the Corps' Federal interest such as the scheduling of ferries to and from Crisfield, medical helicopter landing areas, road paving, and the lack of young couples on the island.

3.1.2 Agency Input

During the feasibility study, agency input was solicited as part of NEPA coordination. Study initiation letters were sent to interested agencies and elected officials to solicit input, and a public notice was issued on October 29, 1998 (Appendix B). The USFWS has been an active participant in the study process since the reconnaissance phase. USFWS representatives attended many study team meetings to offer an agency perspective. Furthermore, the main environmental agencies for the State of Maryland (MdDNR and MDE) are non-Federal sponsors, and, therefore, had continual input throughout the problem identification and plan formulation processes.

In March 1999, the study team held a site visit and meeting on Smith Island for the interested state and Federal agencies. Representatives from NMFS, USFWS, MDE, MdDNR, Somerset County and USACE attended. During the site visit, the attendees were shown the proposed Corps project areas; and potential solutions, alternatives, and impacts were discussed. Reaction from the agencies was used during the design of the preliminary alternatives. This report will be distributed to the agencies for review and comment before being finalized.

3.1.3 Problem Areas Identified for Further Study

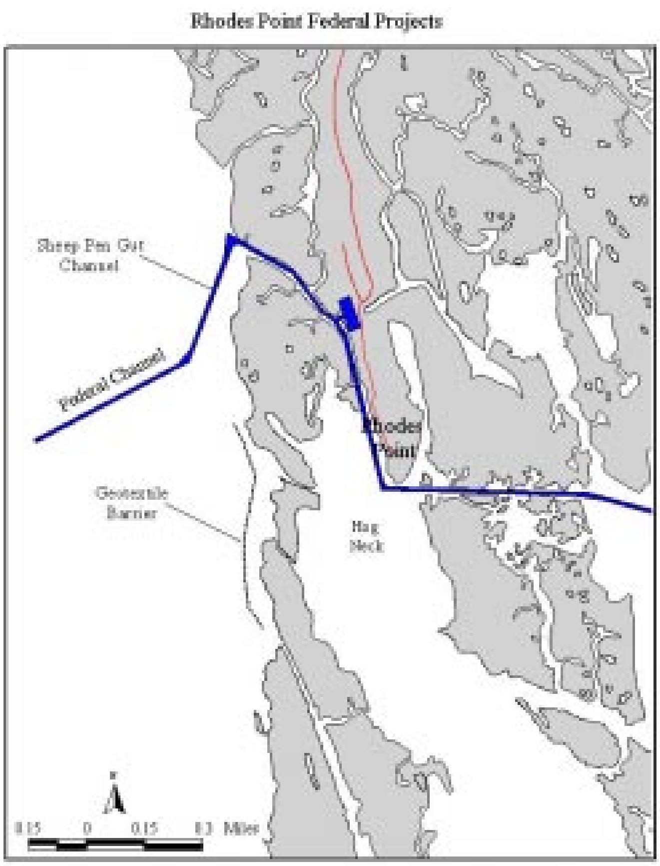
This section provides a discussion of the problem areas that were identified during the feasibility study that were within the Federal interest and Corps authority to pursue for implementation. The project sub-areas were defined during the reconnaissance phase. A summary of projects recommended at each of these areas is presented in Section 1.6.1. Each area was analyzed again in the feasibility phase in greater detail and with updated survey, geotechnical, hydraulic, and environmental data.

3.1.3.a Tylerton. Previously calculated estimates indicate that the shoreline along the southern end of Tylerton is experiencing an erosion rate of about 1-foot per year. The shoreline along the southern part of Tylerton has eroded to the road. Monthly high tides and storms cause flooding of the road and some houses. Much of the western shoreline is bulkheaded; however, it is generally in disrepair and in need of replacement. The southern shoreline is eroding quickly resulting in the loss of wetlands, diminished coverage of SAV in Tyler Creek, and increased nuisance flooding in the town. The study analyzed the existing conditions at Tylerton, and the western and southern shorelines were considered major problem areas. In addition to the economic and environmental benefits of solving the problems in Tylerton, the study team recognized the social and cultural assets of the town, and its importance and relevance to the tradition of the Chesapeake Bay watermen.

3.1.3.b Rhodes Point. The Hog Neck barrier island to the west of Rhodes Point helps shelter the community from the damaging effects of storms and from the Chesapeake Bay (Figure 3.1). The Bay shoreline of Hog Neck directly to the west of Rhodes Point is being stabilized with geotextile tubes placed by Baltimore District, USACE, as part of an ongoing maintenance of the Sheep Pen Gut channel. The geotextile tubes are filled with material dredged from the channel, and retain marshland created using additional dredged material. Although several of the tubes have failed, the created marshland behind the tubes appears to be stable and offering protection to the peninsula and the town. Analysis conducted during the study shows that the northern and southern points of the mouth of

Sheep Pen Gut and the nearby shorelines are eroding at a rate of 13 feet per year, thereby causing tremendous littoral drift of sediment (net movement is north to south) and allowing high wave energy and sediment to pass between Hog Neck and Rhodes Point. This situation is causing erosion of the northern end of Rhodes Point, sediment accretion at the southern end of town, rapid shoaling of the Federal channel, and is contributing to the loss of SAV in Shanks Creek. The constantly widening mouth also exposes the town to a higher risk of storm damage. The determination was made that halting the erosion at the mouth of Sheep Pen Gut was important from many standpoints. Environmental and economic professional judgement dictated that a recommendation to protect the shoreline of Rhodes Point was not justifiable, nor was construction of a structure at the mouth in the interest of SAV restoration. However, the importance of stabilizing the shoreline for navigation, and to protect the channel from rapid shoaling was determined to likely be justified based on USACE cost/benefit criteria, and was carried forward to more detailed analysis and plan formulation separately from this report and EA.

Figure 3.1: Location of Hog Neck and Rhodes Point Projects



3.1.3.c Martin National Wildlife Refuge. Through public coordination efforts with the residents of Ewell and the USFWS, it was determined that the most pressing need in the area was to repair the breaches along the western shoreline of the Martin National Wildlife Refuge (Figure 3.2). Residents from Ewell and USFWS agree that these breaches are causing, or at least exacerbating, the loss of SAV in Big Thorofare and causing increased rates of shoaling in the Federal navigation channels in the area. The correlation between erosion, wave energy, and SAV loss was confirmed during the feasibility study and is discussed later in this report. The increased wave action is becoming a hazard to navigation as well as causing increased rates of erosion to portions of Ewell. The erosion of land around Big Thorofare exacerbates the loss of SAV by causing siltation of the beds, and reduced light availability to the plants caused by excess suspended solids and nutrients in the water column. The total amount of SAV lost in Big Thorofare since 1992 is estimated at over 1,700 acres.

The coves along the north and east shorelines of the Martin National Wildlife Refuge are in various states of degradation. Although the coves are still very productive, they have lost habitat value recently from losses in SAV coverage and wetlands and are in danger of further degradation. Fog Point Cove, Back Cove, and Terrapin Sand Cove have all shown a decrease in SAV since the early 1990's. Although there are other coves that could potentially be repaired, these three have been chosen due to their continued ecological value and uncertain future. The dominant problems are extensive marsh erosion and SAV degradation.

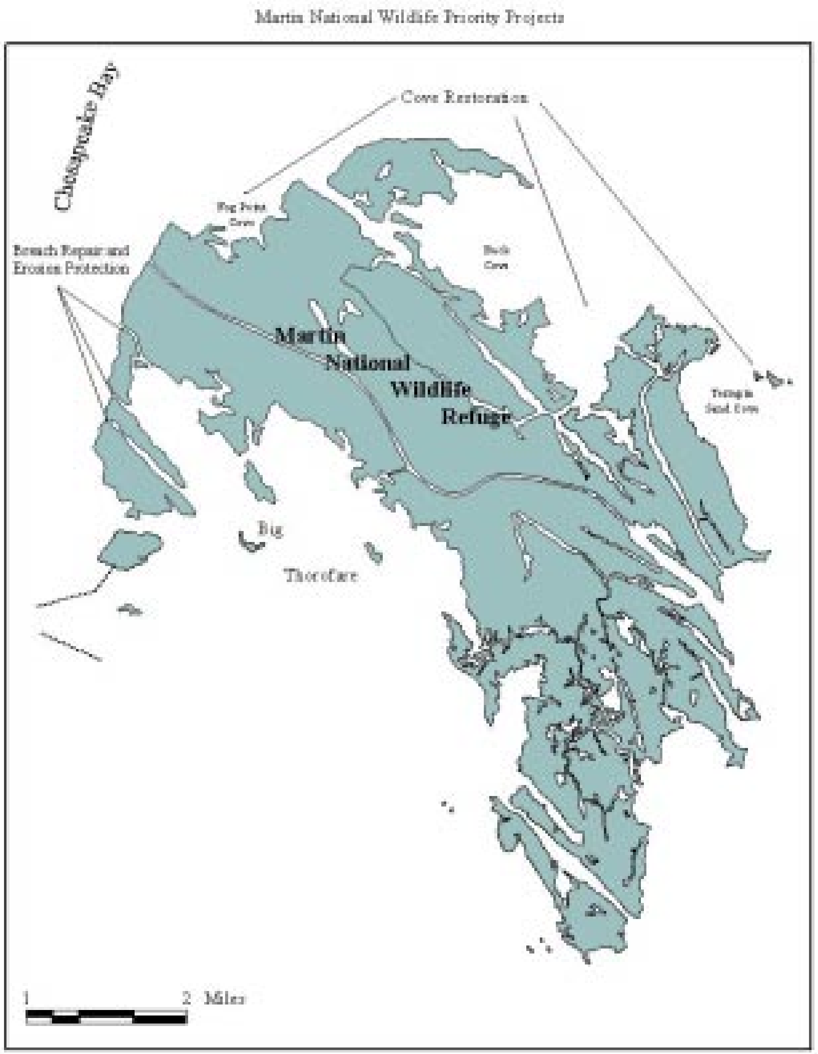
3.2 OPPORTUNITIES FOR CORPS INVOLVEMENT

Many problems were identified in the reconnaissance phase that were not in the Corps' federal interest but were important to the residents of the Island. Only those problems listed in Section 3.1.3 were considered during the feasibility study. A project to address these problems could be considered by the USACE under the missions of environmental restoration, navigation, flood control, and erosion protection in the interest of public infrastructure. The environmental restoration recommendations around the Martin National Wildlife Refuge are the focus of this report. The remaining problems, Rhodes Point and Tylerton, have been addressed separately for reasons discussed in Section 3.2.1.

3.2.1 Overview of Non-Environmental Restoration Plans

All of the identified problems discussed above were considered during the feasibility phase of the study. As the study progressed, the plans being considered for Ewell and the Martin Wildlife Refuge were combined since they were similar plans with similar environmental benefits. That is, they were all offshore or shoreline protection in the interest of SAV growth and protection, wetlands protection and restoration, shallow water habitat protection, diamondback terrapin habitat protection and creation, and the like.

Figure 3.2: Priority Project on Martin Wildlife Refuge



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The other two study areas fell under different missions (non-environmental) and are being analyzed separately, as presented below. USACE higher authority concurrence was requested by the study team and granted for "spinning-off" these actions to be more efficient. The following discussions address the implementation of the Tylerton and Rhodes Point projects, which are documented in detail in separate reports.

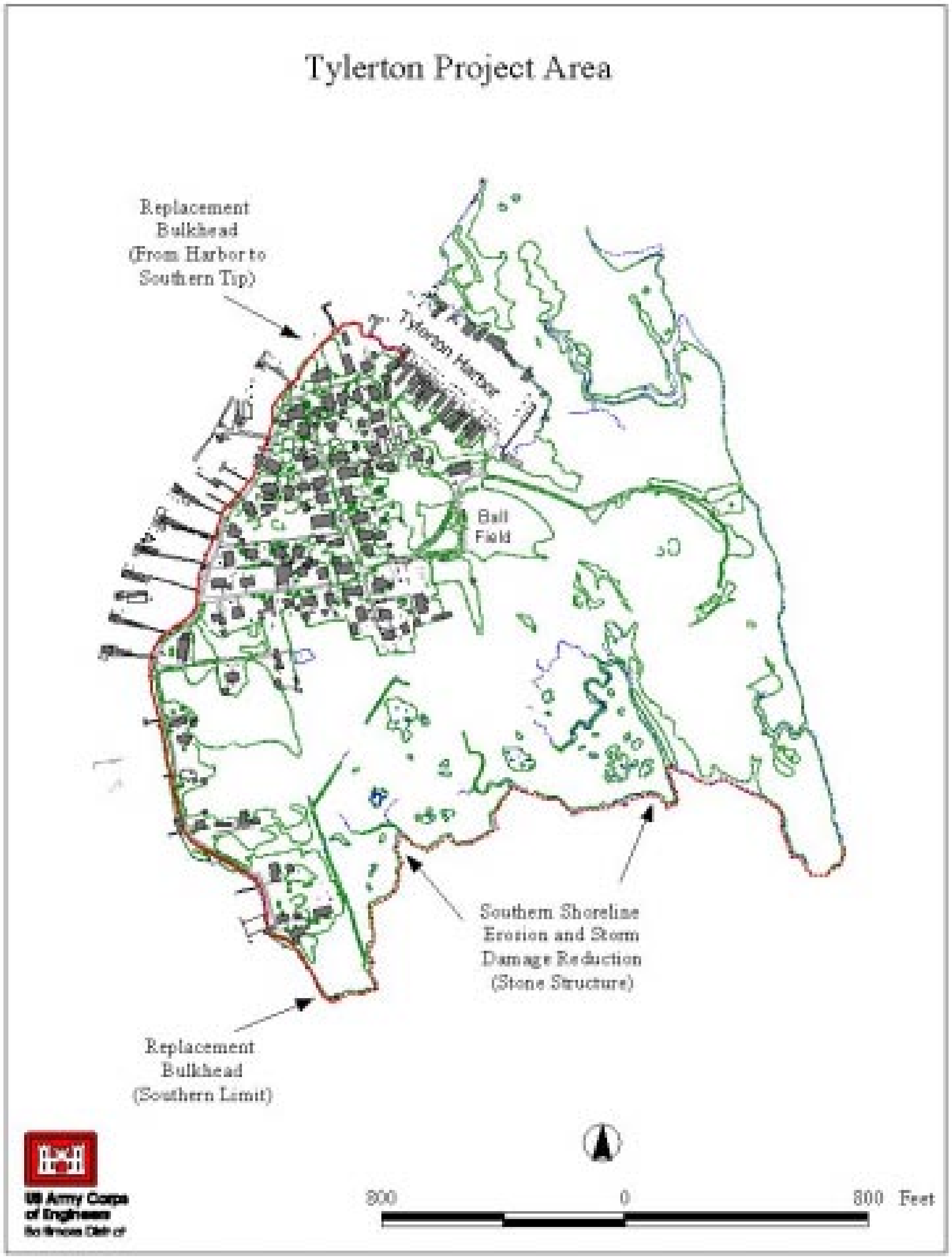
3.2.1.a Tylerton – Section 510. During the reconnaissance phase, severe erosion along the western and southern shoreline of Tylerton was identified as a significant problem that required immediate attention. The town was undergoing severe shoreline erosion, which would ultimately result in damage to the road, sewer and utility lines, and damage to houses, crab shanties, and other structures. An existing bulkhead was in total disrepair and the erosion was continuing beyond the structure. The Tylerton plan was identified as critical to the inhabitants of the Island and was removed from this feasibility study to be implemented under Section 510.

Under Section 510 of the Water Resources Development Act of 1996, “Chesapeake Bay Environmental Restoration and Protection Program”, the Secretary of the Army is authorized to establish a pilot program to provide assistance to non-Federal interests in the Chesapeake Bay watershed. The assistance shall be in the form of design and construction of projects affecting the Chesapeake Bay estuary, including projects for sediment and erosion control; protection of eroding shorelines; protection of essential public works, wastewater treatment and related facilities; beneficial uses of dredged material; and other related projects that may enhance the living resources of the Chesapeake Bay estuary. The Federal share of the total project costs is 75%. Operation and maintenance of constructed projects is funded at 100% non-Federal cost.

In the USACE fiscal year 1998 budget, $939,000 was appropriated for a Section 510 project for Tylerton, Smith Island, Maryland, in the interest of shoreline protection and flood control. The Smith Island project Executive Committee met in March 1999 and agreed to remove the Tylerton plan from the larger feasibility effort and implement it under Section 510. A fact sheet was prepared for approval by USACE higher authority and the plan was approved for implementation as a project under Section 510. Additional funding was added to fund the project in later fiscal years. The EA was completed and a Finding of No Significant Impact was signed in February 2000. The project cooperation agreement was signed in April 2000. Construction is scheduled to commence in March 2001 and will take approximately 9 months to complete.

The Tylerton project will involve shoreline protection for two areas in Tylerton, the western and southern shore areas, as shown in Figure 3.3. These areas receive the majority of wave energy and are experiencing the most severe erosion. The shoreline stabilization plan would include approximately 2,200 feet of protection placed along the western shoreline of Tylerton. This plan includes protection extending approximately 18 inches channel-ward of the existing bulkhead. The project footprint on the western shore would be approximately 3,300 square feet. Along the southern shoreline, the proposed plan calls for the protection of a maximum of 3,500 linear feet. This will protect the critical SAV areas by reducing suspended solids, improving water clarity, and limiting disturbance to recently eroded areas. It is expected that the project will include in-kind replacement of the existing bulkhead on the western shoreline, with a stone toe added for benthic habitat and scour protection and a near-shore, low-profile stone sill on the southern shoreline.

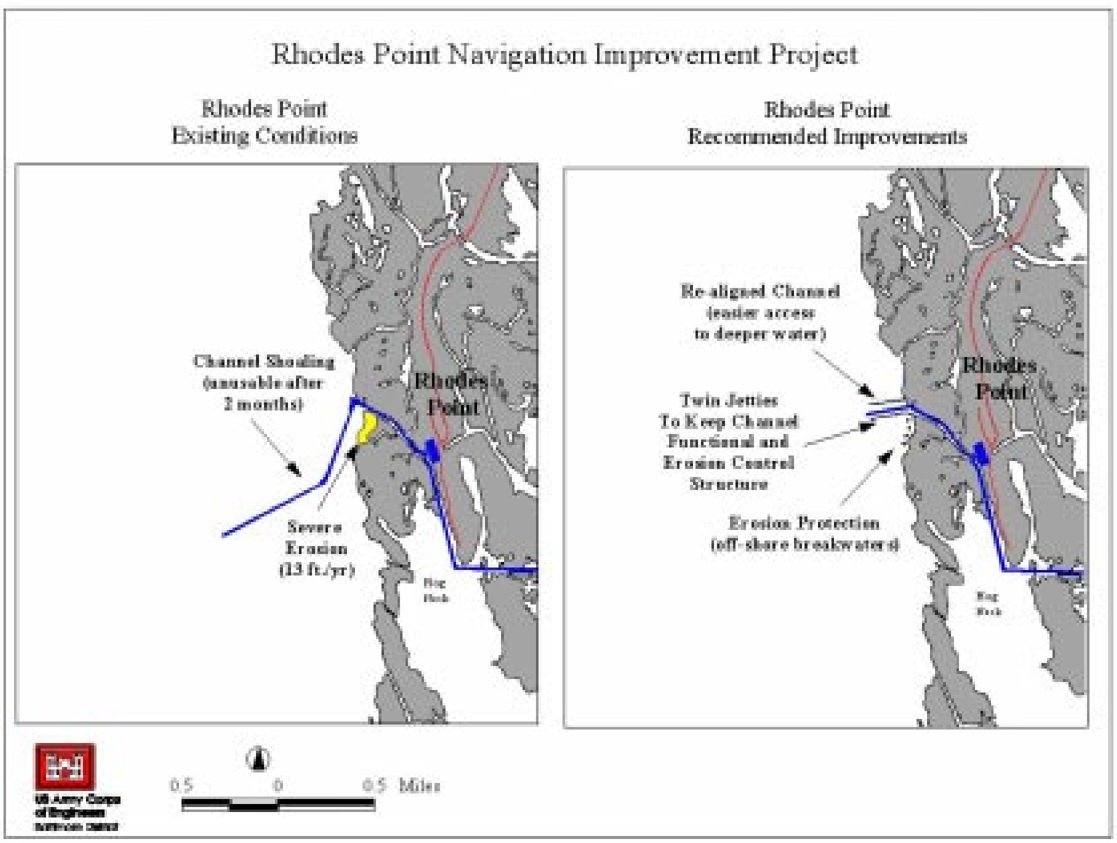
Figure 3.3: Location of the Tylerton Project, Implemented Under Section 510



3.2.1.b Rhodes Point – Section 107. During the reconnaissance study, the Rhodes Point navigation plan was identified as a critical need to the watermen of the island. Currently, there is an existing Federal channel that connects Tylerton and Rhodes Point to the Chesapeake Bay through Sheep Pen Gut (Figure 3.4). The mouth of the Gut, as well as the entire western shoreline of Smith Island, is highly erosive. The littoral movement of eroded sediments causes the channel to shoal within months after maintenance dredging. The watermen are forced to travel through Tyler Creek and Big Thorofare in order to get to prime crabbing grounds in the Bay. This trip is time-consuming and requires much additional fuel. The recommendation, as envisioned, would call for stabilization of the mouth of Sheep Pen Gut, realignment of the channel, and protection of the channel from shoaling by twin jetties.

In order to implement this plan as efficiently as possible, the study team requested authorization from USACE higher authority to switch it from the Smith Island Environmental Restoration and Protection general investigation feasibility study to Section 107 of the River and Harbor Act of 1960, as amended. Section 107 provides authority for the USACE to develop and construct small navigation projects for harbor protection. Permission to use Section 107 was given by North Atlantic Division USACE during a study milestone meeting in April 2000. The Section 107 feasibility report with integrated EA will be completed for public review in early 2001. Construction will follow in fiscal year 2002 if adequate funding is available.

Figure 3.4: Rhodes Point Navigational Improvement Project



3.3 RESOURCE SIGNIFICANCE OF MARTIN NATIONAL WILDLIFE REFUGE PLANS

According to the USACE Institute of Water Resources (IWR) Report 96-R-7, environmental resources must be 'significant' to be considered in plan formulation and evaluation for environmental restoration projects. According to this report,

> *'Significant environmental resources are defined as those that are institutionally, publicly, or technically recognized as important…In terms of environmental plan formulation and evaluation, the significance of environmental resources based on their non-monetary values may be established by institutional, public, or technical recognition of the importance of the environmental resources or attributes of the study area.'* (IWR Report 96-R-7, 1996: 3).

Significance based on institutional recognition is defined as the acknowledgement that the resource is important through laws, policy statements, or plans of public agencies or private groups. Significance based on public recognition is defined as formal or informal acknowledgement that the resource is important, whether through letters, conflict, or support from citizens or landowners. Significance based on technical recognition is defined as important based on scientific or technical knowledge of the resource's characteristics. Most environmental resources are recognized under multiple categories.

3.3.1 Submerged Aquatic Vegetation (SAV)

SAV is recognized as an important environmental resource and Smith Island is connected to one of the largest SAV beds within the Chesapeake Bay. Below are discussions on the significance of SAV from different sources.

3.3.1.a Institutional Recognition. SAV has been recognized by the Chesapeake Bay Program as a critical resource within the Chesapeake Bay, and is a priority for protection and restoration. The Chesapeake Bay Program is a multi-agency task force designed to protect and restore the Bay ecosystem. The Chesapeake Bay Program is a product of the Chesapeake Bay Agreement, signed on June 28, 2000, by the States of Maryland, Virginia, Pennsylvania, the District of Columbia, and the EPA.

The Bay Agreement states:

> *The Chesapeake Bay's natural infrastructure is an intricate system of terrestrial and aquatic habitats, linked to the landscapes and the environmental quality of the watershed. It is composed of the thousands of miles of river and stream habitat that interconnect the land, water, living resources and human communities of the Bay watershed. These vital habitats–including open water, underwater grasses, marshes, wetlands, streams and forests–support living resource abundance by providing key food and habitat for a variety of species.* ***Submerged aquatic vegetation*** *reduces shoreline erosion while forests and wetlands protect water quality by naturally processing the pollutants before they enter the water. Long-term protection of this natural infrastructure is essential.* (Chesapeake Bay Agreement, 2000: 4).

The specific program goals for SAV within the Bay Agreement are as follows:

- *Recommit to the existing goal of protecting and restoring 114,000 acres of submerged aquatic vegetation (SAV).*

- *By 2002, revise SAV restoration goals and strategies to reflect historic abundance, measured as acreage and density from the 1930s to the present. The revised goals will include specific levels of water clarity which are to be met in 2010. Strategies to achieve these goals will address water clarity, water quality and bottom disturbance.*
- *By 2002, implement a strategy to accelerate protection and restoration of SAV beds in areas of critical importance to the Bay's living resources.* (Chesapeake Bay Agreement, 2000).

The Chesapeake Bay Agreement serves as the guiding document for all Chesapeake Bay restoration activities and provides a unified framework for interagency activities. Within Maryland, it serves as a guideline for specific programs and policies within the MdDNR and MDE. Programs include the MdDNR's 'Bay Grasses in Classes' and restoration actions in Middle River, Sue Creek, Stoney Creek, and Harness Creek. In addition, MdDNR has been charged with the regulation of dredging or fill activities that may impact SAV, highlighting the institutional significance of the resource.

The goal of 114,000 acres represents a doubling of the 67,000 acres of SAV found in 1998 to its historic extent. To achieve this goal, it is necessary to protect existing SAV from further decline and to restore SAV in formerly vegetated areas. The Chesapeake Bay Program, charged with implementing the Bay Agreement, has developed a three tiered SAV restoration strategy:

- *Tier I goal: To restore or establish SAV in areas of historic (1971 to 1990) distribution.*
- *Tier II target: To restore or establish SAV in potential habitat to a depth of 1 meter.*
- *Tier III target: To restore or establish SAV in potential habitat to a depth of 2 meters.* (Chesapeake Bay Program, 2000).

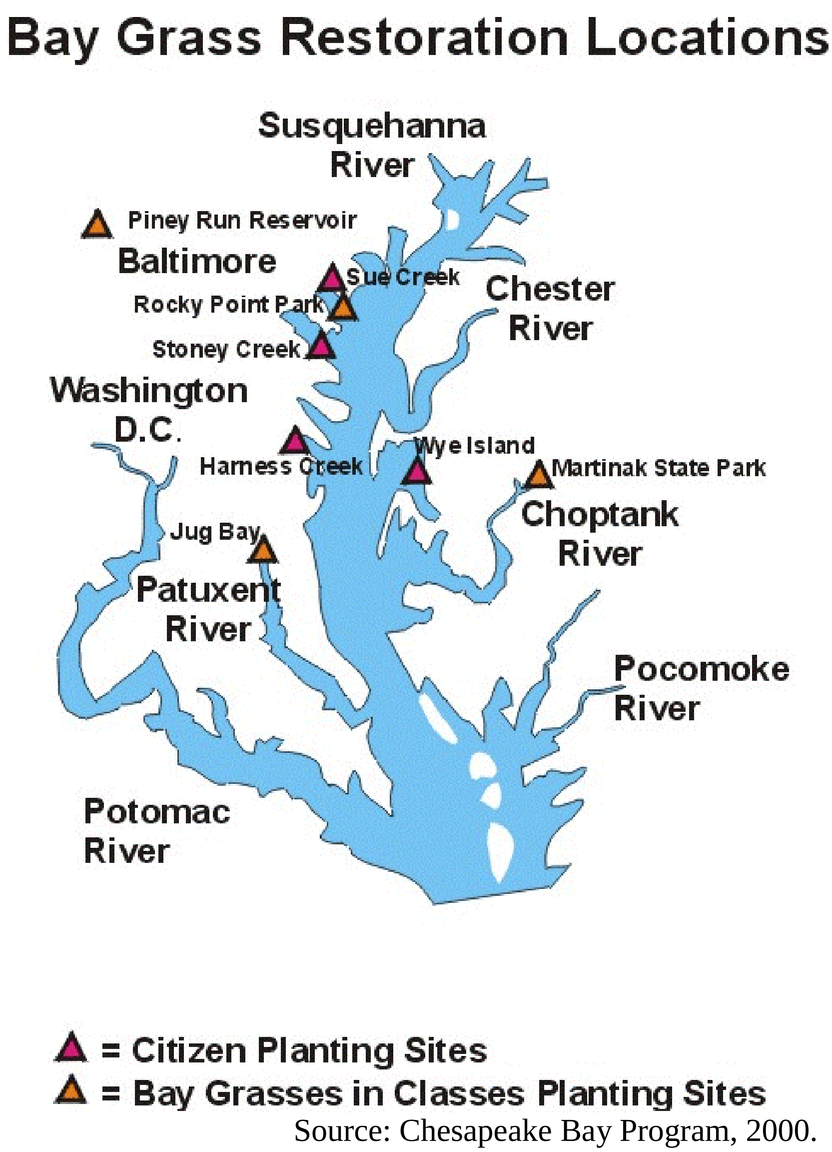
Since 1998, the Bay Program, in partnership with a number of schools, universities, and non-profit organizations, and volunteers, has implemented a number of SAV restoration projects. The project sites are shown in Figure 3.5.

3.3.1.b <u>Technical Recognition</u>. The scientific and resource management community has recognized SAV as an extremely valuable resource. The MdDNR writes:

> *'Sometimes called the forest of the oceans,* ***submerged aquatic vegetation*** *(SAV) or bay grass is one of the most important elements of a healthy bay. Bay grass is part of the foundation of the Chesapeake Bay food chain. Bay grass communities provide habitat for invertebrates, fish and shellfish, and are a significant food source for ducks and fish. Bay grass also significantly improves water quality by absorbing nutrients, slowing water movement, reducing wave energy and removing suspended solids.'* (MdDNR SAV Restoration Report, 2000).

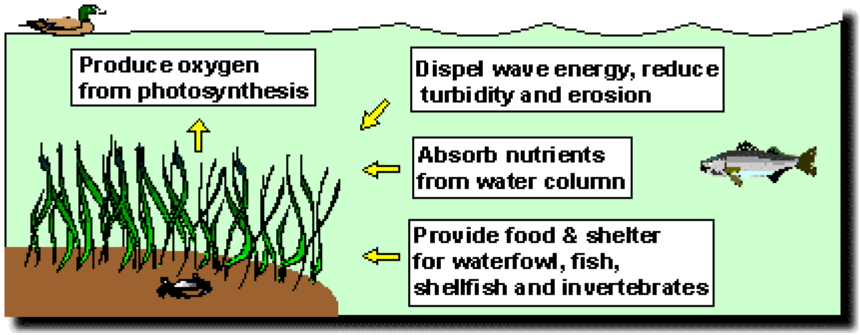
Koch (2000) identifies the following functions of SAV: primary production, fisheries habitat, nutrient uptake, wave attenuation, reduction in current velocity, and sediment stabilization. These functions are shown in Figure 3.6. In terms of primary productivity, measured through carbon uptake, SAV beds are as productive as temperate forests (Dring, 1992). In an era of global warming, the carbon sink associated with seagrass beds has become extremely important. Equally as important, is the role that the SAV provides for waterfowl, especially dabbling ducks. Dabbling ducks typically tip forward into the water, grazing on the shallow vegetation. These include the ruddy duck, green-winged teal, and American wigeon, each of which can be found on grass beds in Chesapeake Bay during their annual migrations.

Figure 3.5: SAV Restoration Locations in Maryland.



Source: Chesapeake Bay Program, 2000.

Figure 3.6: Known Beneficial Functions of SAV



Source: Maryland Department of Natural Resources, 2000

SAV has also been identified as extremely productive fishery habitat, both in terms of species diversity and abundance of organisms (Koch, 2000; Lubbers, et. Al, 1990). SAV beds have been estimated to contain approximately 75 different species of macrofauna and anywhere from 12,000 to 70,000 individuals per square meter (Orth and Vaan Montrfans, 1982). The SAV beds provide food and protection for a variety of species, especially spot, striped bass and blue crab. The numbers of blue crab found in SAV is astronomical, with roughly 1 crab per square foot of SAV during the peak season. A number of species, including the Chesapeake sea horse, pipefish, and stickleback, live solely in SAV beds throughout their lifecycle (Lippson and Lippson, 1997). SAV has also been found to reduce the wave velocities as much as 43% with dense coverage throughout the water column, although in shallow waters, wave attenuation has been observed to be between 1.6 and 7.7%, with less dense coverage (Koch, 2000). SAV can also reduce the current velocity by 2 to 10 times, when compared to non-vegetated areas (Koch, 2000). Finally, SAV can trap sediment, preventing the sediment from entering the water column contributing to TSS (total suspended solids).

3.3.1.c Public Recognition. The public has recognized SAV as a significant environmental resource, as shown through the volunteer SAV planting sessions organized by the MdDNR and Chesapeake Bay Foundation. Volunteer plantings have occurred throughout the Bay and have organized support from local schools, universities, government agencies, and the public. Four Citizen Planting Sites were restored, as shown in Figure 3.4.

The Chesapeake Bay Foundation (CBF), a non-profit environmental organization, is dedicated to the restoration of the Chesapeake Bay. The CBF has identified SAV as a key component in the overall health of the Bay and has made SAV protection and restoration an important part of their restoration strategy.

In addition, SAV decline has been the focus of front-page newspaper articles in the Baltimore Sun, the leading daily newspaper in Maryland. The headline from September 26, 2000 reads: '***Sea grasses vanish, marine life in peril.*** *Scientists see it the world over: Where excess nutrients wash into coastal waters, the undersea landscape changes drastically and marine nurseries are destroyed*' (Horton and Dewar, 2000).

3.3.2 Wetlands

3.3.2.a Institutional Recognition. Wetlands have been recognized as an extremely significant natural resource and are carefully regulated by the Maryland Department of the Environment and the Corps of Engineers. However, the protection and restoration of wetlands has become a priority to the multi-agency Chesapeake Bay Program and is a key component of the Chesapeake Bay Agreement. The Chesapeake Bay Agreement contains specific goals and targets for watershed restoration within the Bay ecosystem. The Bay Agreement contains the following wetland goals:

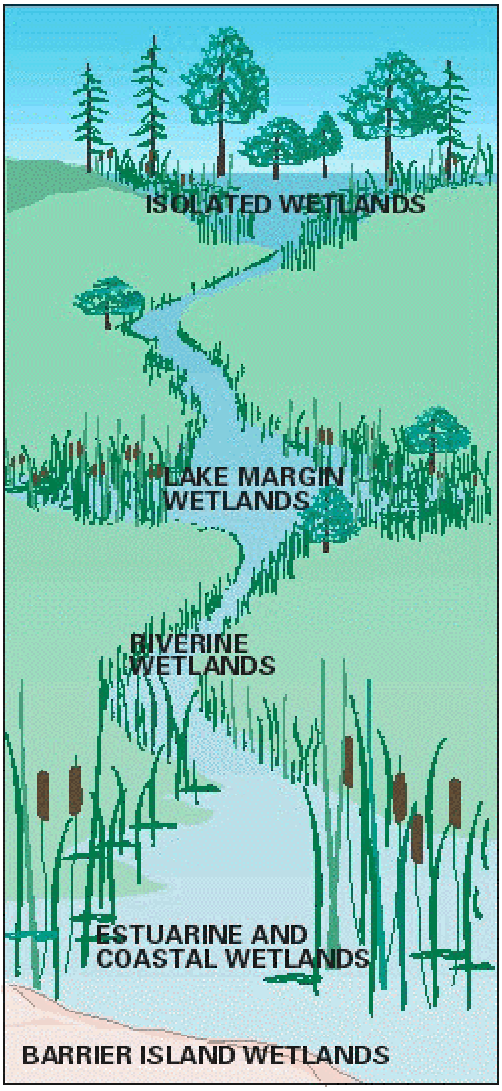
- *Achieve a no-net loss of existing wetlands acreage and function in the signatories' regulatory programs.*
- *By 2010, achieve a net resource gain by restoring 25,000 acres of tidal and non-tidal wetlands. To do this, we commit to achieve and maintain an average restoration rate of 2,500 acres per year basin wide by 2005 and beyond. We will evaluate our success in 2005.*
- *Provide information and assistance to local governments and community groups for the development and implementation of wetlands preservation plans as a component of a locally based integrated watershed management plan. Establish a goal of implementing the wetlands plan component in 25 percent of the land area of each state's Bay watershed by 2010. The plans would preserve key wetlands while addressing surrounding land use so as to preserve wetland functions.*
- *Evaluate the potential impact of climate change on the Chesapeake Bay watershed, particularly with respect to its wetlands, and consider potential management options.*

The 2000 Bay Agreement also states that '*we will continue efforts to improve water clarity in order to meet light requirements necessary to support SAV. We will expand our efforts to reduce sediments and airborne pollution, and ensure that the Bay is free from toxic effects on living resources and human health.'* To meet this goal, it is necessary to reduce the amount of suspended solids within the water column, which requires a reduction of shore erosion and the protection of existing marshes.

The importance of the wetlands has been recognized by the USFWS through the incorporation of the northern half of Smith Island into the National Wildlife Refuge System as the Glenn Martin National Wildlife Refuge in 1954. Martin Wildlife Refuge was established to protect the rare wetland/upland hammock ecosystem and to provide a haven for birds and anadromous fish. The refuge is currently managed by the Blackwater Wildlife Refuge regional office in Cambridge, MD.

3.3.2.b Technical Recognition. The scientific recognition of wetlands and their importance to the hydrologic cycle has been recognized since the 1970s. Research over the past few decades has added a better understanding of wetland functions and increased the awareness and appreciation of wetland roles (USGS, 2000). Wetlands have been identified as providing a number of critical functions, including wildlife habitat, water quality improvement, sediment stabilization, and flood control. These functions are well documented and a host of different functional assessment models are used to quantify these benefits (such as HGM or EPW). Figure 3.7 shows the functions of different wetlands.

Figure 3.7: Functions of Wetlands (source: USGS Website, 2000)



CHARACTERISTICS AND FUNCTIONS OF WETLANDS

Isolated Wetlands
1. Waterfowl feeding and nesting habitat
2. Habitat for both upland and wetland species of wildlife
3. Floodwater retention area
4. Sediment and nutrient retention area
5. Area of special scenic beauty

Lake Margin Wetlands
1. See "isolated wetlands" above
2. Removal of sediment and nutrients from inflowing waters
3. Fish spawning area

Riverine Wetlands
1. See "isolated wetlands" above
2. Sediment control, stabilization of river banks
3. Flood conveyance area

Estuarine and Coastal Wetlands
1. See "isolated wetlands" above
2. Fish and shellfish habitat and spawning areas
3. Nutrient source for marine fisheries
4. Protection from erosion and storm surges

Barrier Island Wetlands
1. Habitat for dune-associated plant and animal species
2. Protection of backlying lands from high-energy waves
3. Scenic beauty

Tidal wetlands are particularly important, especially within the Chesapeake Bay estuary, which is ringed by large expanses of tidal wetlands. The Bay Program writes:

> *Estuarine wetlands are particularly important habitats for brackish and marine fishes and shellfish, various waterfowl, shorebirds and wading birds and several mammals. Most commercial and game fishes use estuarine marshes and estuaries*

> *as nursery and spawning grounds. Menhaden, bluefish, flounder, sea trout, mullet, croaker and striped bass are among the most familiar fishes that depend on estuarine wetlands. In fact, the Chesapeake Bay is the major spawning and nursery ground for striped bass on the East Coast. Blue crabs, the prized shellfish of the Bay, also depend on coastal marshes, as do other shellfish, such as oysters, clams and shrimp (Chesapeake Bay Program, 2000).*

The EPA Office of Water also states:

> *Wetlands are among the most biologically productive natural ecosystems in the world. They can be compared to tropical rain forests and coral reefs in the diversity of species they support. Wetlands are vital to the survival of various animals and plants, including threatened and endangered species like the wood stork, Florida panther, and whooping crane. The U.S. Fish and Wildlife Service estimates that up to 43% of the threatened and endangered species rely directly or indirectly on wetlands for their survival* (EPA, 2000).

The wetlands on Smith Island are noted for their pristine condition, which enhances their value to the Bay ecosystem. The wetlands on Smith Island are part of the Atlantic Flyway, which is a migratory pathway for thousands of migratory birds, connecting Canada and New England to the Caribbean. The combination of upland and wetland provides a valuable stopover site within the migratory pathway.

3.3.2.c Public Recognition: The public has grown increasingly aware of the value of wetlands and their importance in a number of critical functions. A diverse group of environmental organizations and non-profit agencies have taken a pro-active stance towards wetland restoration. These groups include Ducks Unlimited, the Sierra Club, and the Nature Conservancy, each of whom are engaged in different restoration activities in Maryland. The CBF, one of the largest environmental organizations within the Bay watershed, operates an environmental education facility in Tylerton, using the exceptional marshes of the area an educational resource.

3.3.3 Uplands

3.3.3.a Institutional Recognition. Upland habitat is not generally protected through institutional networks, as is the case for SAV and wetlands. However, the upland environments on Smith Island are dramatically different from conventional uplands. Upland environments on Smith Island have been incorporated into Martin Wildlife Refuge and managed for breeding populations of colonial waterbirds. In addition, the MdDNR has advocated a green infrastructure program, designed to connect expanses of upland into larger migratory paths for wildlife.

The importance of Smith Island uplands is through their use as colonial waterbird rookeries. Protection of these rookeries from human disturbance and erosion is a high priority for the MdDNR Wildlife and Heritage Division. The MdDNR's Program Open Space evaluated the upland areas in 1990 and has identified the nesting sites as important locations to protect.

3.3.3.b Technical Recognition. As isolated hammocks surrounded by marsh, the USFWS has identified these sites as important colonial waterbird nesting sites. Somerset County is responsible for 20% of Maryland's colonial waterbird population and Smith Island is recognized as having more waterbird colonies per area than any other location in the Maryland.

The uplands are part of the Bay island ecosystem, providing protection from development, human disturbance, cultivation, and exposure to predation by domestic animals, which are factors that limit the available habitat on the mainland. The upland rookeries were surveyed in 1995 and the following species were identified as having sizable breeding populations on Smith Island: black-crowned night heron, great black-backed gull, yellow-crowned night heron, glossy ibis, tri-colored heron, great egret, great-blue heron, herring gull, cattle egret, little blue heron, and snowy egret. The State of Maryland lists the glossy ibis and little blue heron as rare species.

3.3.3.c Public Recognition. The public has recognized upland habitat as having exceptional value to birds and other species. The blue heron is a symbol of the Chesapeake Bay and both shorebirds and colonial nesting birds are closely monitored in the bay by groups such as the Maryland Ornithological Society. The uplands of Smith Island have been recognized by the local communities as extremely valuable bird habitat.

3.3.4 Mud Flats and Sandy Shores

3.3.4.a Institutional Recognition. The mud flats and sandy shores of Smith Island are recognized as critical parts of the overall island ecosystem. Its importance and rarity led to the creation of Martin National Wildlife Refuge. The refuge has provided protection for numerous terrapin, shorebirds, and migratory waterfowl, which rely on the resources of the mud flats to sustain them. The shoreline and surrounding buffer is considered critical to the overall health of the bay, and has been termed 'critical area,' which is strictly regulated by the Coastal Zone Management Program. The critical area is the area 1000 feet from the bay and has been incorporated into statewide landuse and zoning regulations. Goals of the CZMP include preserving natural shoreline and associated sandy shores and mudflats, and enhancing the existing coastal zone.

3.3.4.b Technical Recognition. The mudflats and sandy shores have been identified as extremely diverse and productive habitat for a variety of organisms. Sandy shores and mud flats represent a flexible border between the uplands or wetlands and the open bay, providing a fringe habitat that allows many species to find necessary food and habitat. Species that use the mudflats include fiddler and hermit crabs, clams, crayfish, mud snails, and dozens of worm species. These species provide an exceptional food source for the numerous colonial nesting birds and avian species. The health of these populations on Smith Island is a result of expansive mud flats that provide the necessary food source.

The sandy shores along Smith Island are known to be exceptional diamondback terrapin habitat, which need access to sand shores for nesting sites, but feed off of the many clams and worms that inhabit the shallow water and mud flats.

3.3.4.c Public Recognition. Although not as visible to the public as emergent marsh or SAV, many environmental groups have recognized the importance of natural shoreline, including mudflats and sandy shores, to the overall health of the Bay. Environmental groups such as the CBF have advocated non-hardened shorelines and non-structural erosion protection measures to protect mud-flats and shorelines.

3.3.5 Shallow Water

3.3.5.a Institutional Recognition. The importance of shallow water as a nursery and fishery is reflected through the fact that the USACE and the NMFS regulate all activities in shallow water. The waters off of Smith Island have been declared Essential Fish Habitat by the NMFS for the following species: bluefish, summer flounder, king mackerel, Spanish mackerel, cobia, red drum, dusky shark, and sandbar shark. Many of these species are primarily found in deeper water, well off-shore of Smith Island. However, windowpane flounder, summer flounder, and bluefish may reside in the shallow water areas near Smith Island.

3.3.5.b Technical Recognition. Shallow water functions as a mixing zone, combining the burrowing creatures of the mudflats with the fish and bottom dwelling organisms of the deeper water. The shallow water functions as an interface between the fish and benthic communities of the Bay and the resources of SAV and mudflats. The clams, worms, snails and other burrowing animals of the mudflats live within the shallow waters, forming the base of the aquatic food chain. These resources support a number of extremely important fish species, including striped Bass, menhaden, summer flounder, winter flounder, bluefish, black drum, and croaker. Some of these are commercially valuable, especially striped bass and menhaden. Juvenile striped bass seek refuge in the shallow waters of the Chesapeake Bay and support between 70 and 90 percent of the mid-Atlantic population. The striped bass fishery has been valued at over $200 million. Menhaden, closely related to the herring, is used extensively as bait, chicken feed, and fertilizer. The dense schools of menhaden enter the Bay to feed on the Bay’s plankton.

Also associated with shallow water, especially SAV beds, is the blue crab. The blue crab is among the most valuable fishery within the Bay, generating nearly 100 millions pounds of crab annually. Blue crabs prefer to forage within SAV, which provides cover and protection from the larger predators, making the large SAV beds around Smith Island one of the most productive blue crab fisheries within the Bay.

Shallow water is necessary for SAV germination, and the depth depends upon the amount of light penetration. In Tangier Sound, the accepted depth for SAV germination is 1 meter.

3.3.5.c Public Recognition. The importance of shallow water is primarily shown through its association with SAV. SAV plantings have become volunteer efforts, utilizing a network of concerned citizens to restore the Bay grasses. Citizens in over a dozen sites have helped plant SAV in shallow water areas, highlighting the personal commitment of many bay residents to this resource. In addition, shallow water is known as exceptional crab and fishing habitat and many associations protect shallow water as a recreational resource.

3.3.6 Island Habitat

3.3.6.a Institutional Recognition. Island habitat has been recognized by the USFWS as providing protected habitats for numerous species of waterfowl, migratory birds, and reptiles. The importance of island habitat has been recognized through a number of large-scale island restorations, especially Poplar Island. In addition, the USFWS has created a habitat island coordinator, charged with the responsibility to preserve and protect the Bay's island habitat, reflecting the growing importance placed on protecting undisturbed habitat.

3.3.6.b Technical Recognition. Island habitat provides a measure of protection from predators and human disturbance for aquatic and terrestrial species. Waterfowl are protected from hunting and other human activities, allowing for more natural population dynamics. More importantly, indirect impacts from development and disturbance are minimized, allowing for large, unbroken habitat areas. Black ducks and colonial waterbirds, in particular, require isolated, protected islands for breeding. Neo-tropical migratory birds also use islands as stop-over sites on their biannual migrations along the Atlantic Seaboard. The USFWS writes:

> *Offshore islands are a unique ecosystem component in the Chesapeake Bay watershed. Although similar vegetative communities may occur on the mainland, isolation, relative lack of human disturbance, and fewer predators make islands more desirable as nesting sites for colonial waterbirds and some endangered species* (USFWS, Poplar Island website, 2000).

The importance of island habitat is the variety of habitat types available within a small area. The habitats provide a number of edge areas where two or more ecosystems interact. Edge systems are known to have higher species diversity and more productivity than independent systems. The Chesapeake Bay island habitat contains shallow water, SAV, mudflats, emergent marsh, and uplands. At the juncture of each habitat, species are able to interact and draw on the resources from the other habitat. On Smith Island, each of these five habitats can be found within two square miles.

3.3.6.c Public Recognition: Groups such as the Nature Conservancy, Ducks Unlimited and Maryland Ornithological Society have recognized island habitat as an important component in the overall Bay ecosystem, especially for migratory waterfowl and colonial waterbirds. These groups have participated in restoration activities designed to preserve island habitats and keep these areas free of development pressure.

Section 4

PLAN FORMULATION AND EVALUATION

4.1. DEFINING THE SCOPE OF THE STUDY

The major task of the Smith Island Environmental Restoration and Protection Study was to formulate and recommend project alternatives that preserve and enhance the ecological integrity of Smith Island in accordance with USACE authorities. The most pressing environmental problems on Smith Island include erosion, breaching of protective landmasses, marsh loss, SAV loss, and other habitat degradation such as of shallow water and sandy beaches. These problems are severe throughout the island, including Martin National Wildlife Refuge, which comprises the northern half of the island and includes many ecologically important coves.

The problems experienced by the residents, notably shore erosion and rapidly shoaling navigation channels, are discussed in previous chapters and were addressed under separate implementation authorities. The Tylerton shoreline protection project is being implemented under Section 510 of the Water Resources Development Act of 1996, and the Rhodes Point small navigation improvement is being considered in a separate feasibility report under Section 107 of the River and Harbor Act of 1960, as amended. The remaining discussions in this report refer to the environmental restoration components of the study, which were selected from earlier problem identification efforts during the reconnaissance phase. As discussed below, alternatives to address the problems at each site were formulated and analyzed in the feasibility phase.

4.1.1 Study Goals and Objectives

The Smith Island ecosystem restoration alternatives were formulated to primarily address the impact of shoreline erosion on SAV and on emergent wetlands. The alternatives were designed to both protect existing SAV and wetlands, and provide conditions necessary for restoration of lost SAV beds. The alternatives formulated to achieve this goal must meet the objectives and fall within the constraints detailed in this section. The environmental benefits and costs of each alternative were evaluated in cost effectiveness and incremental analyses. For each of the Smith Island environmental restoration project component areas, a separate cost-effectiveness and incremental analysis was conducted. This analysis considered the cost of construction and the anticipated environmental benefits to be derived. After the recommended alternative from each site was identified, an overall average cost analysis was conducted to prioritize the alternatives. Since the plans are all designed for environmental restoration and protection, the benefits are not monetary but rather habitat based.

There are significant SAV beds in Big Thorofare and within the coves on the northern and eastern rim of the island. The gradual, continuous erosion of the shorelines of these areas threatens the existing SAV habitat in these areas. Three coves within the Martin National

Wildlife Refuge were identified for restoration and protection. Alternatives were formulated to consider the following objectives. The study process must:

1. Maintain the quality and diversity of the natural and cultural environments.

2. Maximize environmental restoration and habitat creation opportunities.

3. Develop solutions that are appropriate to the scale of the island.

4. Provide opportunities for the beneficial use of dredged material.

5. Aim to reestablish and maintain a healthy population of fish and wildlife, including oysters and crabs, and the natural resource based economy.

6. Maintain or expand, rather than limit, natural resources available to the watermen.

7. Minimize adverse environmental impacts to Smith Island and the surrounding waters of the Chesapeake Bay.

4.1.2 Planning Constraints

Whereas project objectives help to guide the formulation process toward the project goal, constraints are expressions of public and professional concerns about the use of water and land resources in a particular study area. These planning constraints result from the analyses of existing and future conditions within the context of the physical, environmental, economic, and social characteristics of the study area. They are used to formulate alternative plans and to evaluate the effectiveness of those plans. The study team identified the following constraints for the Smith Island Environmental Restoration and Protection Feasibility Study:

1. Select alternatives that will help maintain the Smith Island way of life.

2. Be respectful of the environment. The island wetlands surrounded by the Bay and Tangier Sound compose a singular ecosystem, which contains diverse habitat areas, but functions as a single island system.

3. Respect the uniqueness of the island by maintaining its cultural and environmental integrity. It is important not to force the island into a “mainland mode.”

4. Be sensitive to local opinions and suggestions, and select alternatives that are appropriate to the island and island community.

5. Avoid adverse socio-economic and environmental impacts.

6. Recommended projects must be cost-effective, technically feasible and in the Federal interest.

4.2 MOST PROBABLE FUTURE WITHOUT PROJECT CONDITIONS (NO ACTION)

Without a project to address the shoreline erosion and its impact on SAV habitat on the northern section of Smith Island, the combined loss of emergent wetlands for the four project areas is projected to be 275 acres over the 50-year period of analysis. In addition, the combined marsh loss would expose additional areas of the island to increased erosion, contribute nutrients and solid particles into the Bay waters, and lead to the degradation of over 1,000 acres of SAV. Similar losses of wetlands and other valuable habitat was described and quantified in Section 2.

The no-Federal action, "without-project" condition, represents the baseline from which all changes are measured. The no-action alternative would postpone the work until some future date or abandon the project altogether, and therefore avoid or postpone both positive and adverse impacts that would be associated with construction and operation. The following no-action scenarios are presented for each of the identified project sites. The potential impacts are discussed in greater detail in Section 4.4.

4.2.1 Western Shoreline/Big Thorofare

Under the no-action alternative, erosion along the 9,000-ft. stretch of coastline will continue at approximately 10 to 12 ft. per year. The combined marsh loss is expected to be 135 acres in the next 50 years. The habitat functions of the marsh will be permanently lost to the Bay. More importantly, breaching will continue throughout the western shoreline, exposing Big Thorofare to increased wave energy, sediment, and changing current velocities. Long-term impacts are anticipated through continued SAV decline, interior erosion, and loss of isolated islands. The combined loss of resources is expected to be severe.

4.2.2 Fog Point Cove

Under the no-action alternative, erosion is expected to continue at 10 ft. per year. Wetland losses are expected to top 30 acres over the next 50 years. The cove is expected to continue to lose its protective cover, exposing its SAV and sandy beaches to increased wave energy, destroying the protective areas needed by Terrapin and other wildlife species.

4.2.3 Back Cove

Under the no-action alternative, erosion is expected to continue at 8 ft. per year, resulting in the loss of over 80 acres of tidal marsh over the next 50 years. The peninsula protecting Back Cove is expected to continue to erode, which will lead to breaching and limiting the protected areas within the cove. The cove will be more exposed to large fetches, allowing for more wave energy and less protection from large storm events. An estimated 256 acres of existing SAV habitat is at risk.

4.2.4 Terrapin Sand Cove

Under the no-action alternative, Terrapin Sand Cove is expected to experience complete decline as a protected cove. The extensive breaching is expected to continue until the protecting marsh has completely vanished, exposing 7,000 feet of the eastern shoreline to a larger fetch and permanently destroying the protected habitat. SAV germination is expected to be tenuous and highly variable. The SAV beds are not expected to fully recover in the future.

4.3 ALTERNATIVES FORMULATION

4.3.1 Plan Development

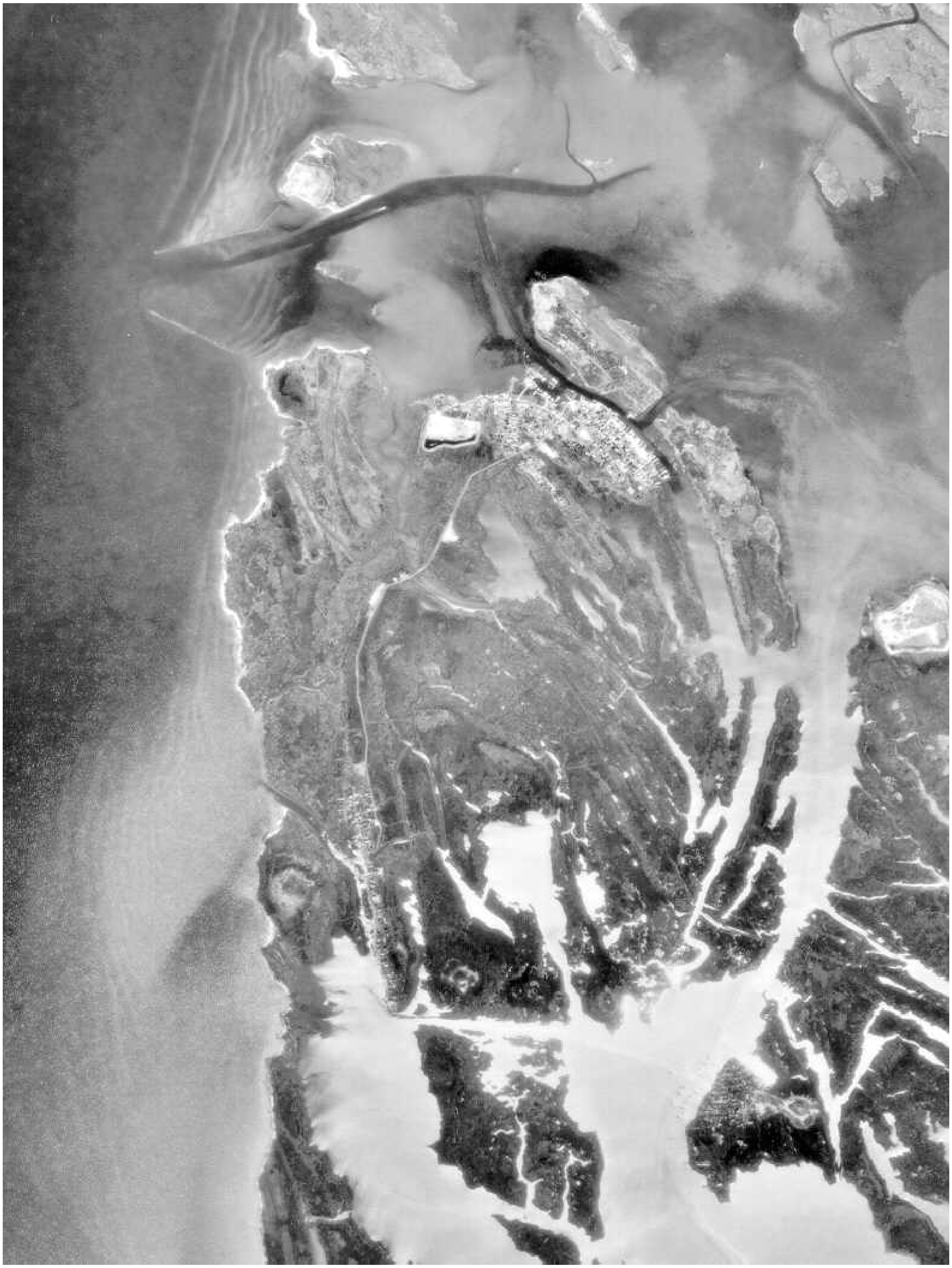
Although SAV restoration is a relatively new science, experience has demonstrated that SAV restoration is difficult. Replanting has proven extremely difficult, and has met with limited success. Nonetheless, it has become clear that the most important factor in the health of SAV beds is the amount of available light reaching the Bay bottom. Several recent projects implemented by the Corps that have improved light penetration have seen SAV colonization, even though that was not the intent of the project. As a result, the Corps formulation process considered techniques that would help improve light attenuation, rather than replanting. Consultation with the FWS, local sponsors, and outside experts, confirmed this decision, as SAV replanting success is not practical without improved water quality conditions.

According to the Chesapeake Bay Program, SAV technical committee, the necessary light attenuation depth for SAV is 1.0 meter, while the average light penetration depth in Big Thorofare is 0.8 meters. In order to increase light penetration, it is necessary to reduce the levels of TSS and nutrients within the water column. Each parameter is the result of both local and regional factors, although only the local factors can be addressed within this study.

The predominant local source is the extensive marsh erosion occurring throughout the island system, contributing substantial levels of sediment and nutrients to the interior waters of the island. More importantly, recent evidence has indicated that the fine marsh sediments are easily re-suspended during even moderate intensity storms, creating turbidity problems for several days after the storm event (see: Moore, et. al, 1997). If these storms re-suspend the sediments during the critical growing season (April-May), lasting damage can occur.

The SAV beds within Smith Island are located behind peninsulas of protecting marsh. However, as these marshes are breached and erode, they contribute large amounts of sediment to the interior areas. The turbidity plumes from the marsh erosion are extensive and are clearly visible from aerial photography. The plumes within Big Thorofare are shown in Figure 4.1. Without protection from continuous sections of marsh, the SAV has a difficulty germinating in the higher energy environment of the open bay. As a result, protecting and stabilizing the marsh sediments, through the reduction in marsh erosion was considered the top priority in restoring the interior SAV beds.

Figure 4.1: Turbidity Plumes within Big Thorofare. Much of Big Thorofare is experiencing extensive sedimentation, a result of the marsh breaching along the Western Shoreline. The Federal channels appear darker due to their depth.



Thus, plan formulation focused on mechanisms that would preserve the marsh peninsulas, repair the breaching, and stabilize the sediment. Because of the high energy on the outside shorelines of the island, structural alternatives were considered necessary. The plans were formulated along the following priorities:

- Breach Repair—to stop the major sources of TSS and nutrients from entering the protected interior.
- Preservation of the marsh peninsulas—to provide a buffer from the extensive wave energy generated from the bay. The marsh buffers create quiescent conditions in the interior coves that are more conducive to SAV germination.
- Sediment stabilization—to prevent the major local sediment source from entering the water column, improving the local light attenuation.

Based on these priorities, a number of structural alternatives were developed to meet these goals and are discussed below. SAV replanting is not recommended because of its high risk and uncertainty. If the appropriate conditions are restored, the SAV is expected to naturally re-vegetate the interior areas.

4.3.2 Structural Alternatives Comparison

The identified alternatives all have the primary objective of protecting habitat from wave and current energy. To accomplish this, the study team considered many structural methods. Non-structural methods were not considered to be applicable since habitat can not be relocated, nor can management changes to the land be recommended when the behavior of the natural land users (wildlife) can not be managed or regulated. Further, many of the structural methods were determined to be impractical due to the high-energy environment at Smith Island, the cost, or other reasons. The following sections describe the structural methods considered and the rationale for selecting methods for the project designs (see Appendix E for more detailed discussions). Under the existing conditions, only stone sills, stone breakwaters, and protected wetland creation were considered viable alternatives to actively prevent further erosion. These techniques were analyzed based on the different project areas and are the basis of the plan formulation. A summary of the techniques is shown in Table 4.1.

4.3.2.a <u>Stone Revetments</u>. A stone revetment is a structure that is constructed along the shoreline to protect it from erosion from wave action. The structure typically consists of large rocks placed over smaller stones and/or geotextile fabric. The final elevation of the structure and the size of the stone used is contingent on the wave climate that must be protected against for adequate project performance. Considering how low the elevation of the land is on Smith Island, a sand dike would have to be constructed along the marsh edge to provide the appropriate slope for revetment construction. Due to the low elevation of the marsh, the dikes would have to be constructed significantly higher than the marsh to prevent significant overtopping of the revetment. This would in essence be similar to construction of a seawall along the perimeter of the island, and would remove all natural shoreline features from the protected area. The cost of such an alternative would be prohibitive and was not considered further.

Table 4.1: Shoreline Protection Alternatives on Smith Island

Technique	Positive Qualities	Negative Qualities	Viable?
Stone Revetment	Will reduce erosion long-term.	Hardened shoreline, extremely expensive, will alter hydrology.	No
Groins	Non-hardened shoreline.	Unlikely to work on Smith Island, will not protect during storms or high tides, may induce further erosion.	No
Non-Traditional Bulkheads and Walls	Non-hardened shoreline, will reduce erosion.	Short project life, unproven technology.	No
Proprietary Methods	Non-hardened shoreline, not expensive.	Very little success within Chesapeake Bay.	No
Artificial Beach Nourishment	Will add beaches to Smith Island, dissipate wave energy on marshes.	Unsuitable shoreline, very expensive, extensive maintenance.	No
Wetland Habitat Development	Will add marsh, reduce erosion.	Works in low energy areas only, needs protection in higher energy areas.	Yes--with protection
Stone Sills	Will provide full erosion protection, allow marsh hydrology, more easily constructed.	Hardened shoreline, extremely expensive.	Yes
Stone Breakwaters	Non-hardened shoreline, will reduce erosion, allow marsh hydrology.	Gaps may limit effectiveness, must be designed properly.	Yes
Geotextile Breakwaters	Non-hardened shoreline, will reduce erosion, allow marsh hydrology.	Low instance of success on Smith Island, sponsor would not support.	No

4.3.2.b Groins. A groin is a structure typically made of stone or wood that is constructed perpendicular to the shoreline to be protected. A groin field is a series of groins that resemble fingers that tie into the shoreline and stick out into the water. Groins work by trapping the longshore movement of sediment (that is parallel to the shoreline), or littoral drift. However, a system of groins does not provide any significant protection during storm events with elevated tide levels. The elevated tides allow waves to attack the shoreline directly, resulting in loss of marsh shoreline sediments in the offshore direction. Groins were not considered as a viable alternative for the study area.

4.3.2.c Non-Traditional Bulkheads and Walls. Innovative shoreline bulkhead and walls constructed of material such as pilings, timber slats, rubber tires, or jersey barriers have been used with mixed success in the Chesapeake Bay and tributaries. Typically, these structures offer only a limited amount of erosion control over a relatively short project life. Due to the extensive scope of the project area, these measures were not considered viable erosion control alternatives for the study area.

4.3.2.d Proprietary Erosion Control Measures. Proprietary structures such as Beach Prisms, Beach Beams, Sand Grabbers, Surge Breakers, etc., have been used with limited success in the Chesapeake Bay region. Because of their limited success, and the extensive scope of the project area, they were not considered viable alternatives for the study area.

4.3.2.e Artificial Beach Nourishment. Construction of a protective beach in several of the erosion problem areas would be an effective measure for shoreline stabilization. The gentle slope of a beach would dissipate incident wave energy and provide a buffer zone to protect shoreline areas. However, due to the wave energy along the Smith Island shoreline, this measure will only be effective when combined with stabilizing structures such as breakwaters or sills. The use of artificial nourishment alone was not considered a viable alternative for the study area. This method would also be extremely expensive, and maintenance intensive, since much of the island experiences erosion on the order of 10 feet per year. A source for a sufficient volume of material is not likely to be found at a reasonable cost.

4.3.2.f Wetland Habitat Development. Wetland habitat development, likely using dredged material, could reclaim some of the protective wetland that is continually lost to erosion. Wide wetland areas would be an effective wave dissipation measure to control erosion along the shoreline. Unconfined material could not be stabilized by vegetation before the wave energy in the area would destroy it. To insure the stabilization and protection of the wetland area, structural protection such as sills or breakwaters will be required, and the area would need to be planted, since natural colonization could not occur quickly enough. Therefore, wetland development without protective structures was not considered a viable alternative for the study area. Wetland habitat development as a component of another stabilization method was considered further.

4.3.2.g Breakwaters/Sills. Breakwaters are typically stone structures built parallel to the shoreline some distance from the shoreline, although they can be built along the shoreline. Breakwaters are frequently built in sets with a gap in between them to protect the shoreline yet allow water to circulate behind them (in the lee). The reduced wave energy zone on the lee-side of an offshore breakwater that protects the shoreline usually results in a deposition of littoral drift moving along the shore in the protected area. A number of plan configurations are possible with the breakwaters including with or without gaps, the size of the gaps, the length of the structures, and the like. A series of breakwaters without gaps in between forms a continuous line of protection called a sill. The crest elevation can be high or low depending on whether the design requires that the design wave break on the structure or be allowed to overtop it. Typically, for the projects considered for Smith Island, sills were conceived to be built close to shore with low crests, often submerged. Economics and engineering constraints as well as environmental concerns will dictate the most feasible configuration. Table 4.2 presents the pros and cons of the various breakwater and sill configurations.

Sandy borrow material may be placed in the lee of these structures to provide additional protection from overtopping waves. The areas created by placing fill shoreward of breakwaters can subsequently be left as beach or planted with wetland vegetation to help stabilize the fill and create habitat. The shoreline response resulting from the construction of breakwaters is governed by the resulting changes in the longshore sediment transport, and the onshore-offshore sediment transport in the vicinity of the breakwater. The effects on sediment transport are a function of the structure length, crest elevation, permeability, gap width, and distance from the shoreline. Generally, following breakwater construction, a new equilibrium shoreline will be established in response to the altered transport processes.

Breakwaters provide a cost-effective shoreline stabilization method that allows for the possibility of creating habitat in the lee and segmented breakwaters allow non-hardened shoreline to remain in the area. More detail on breakwaters and sills can be found in USACE document EM 1110-2-1617.

4.3.2.h Geotextile Breakwaters. Breakwater structures in the Chesapeake Bay region are usually constructed of armor stone. However, sand-filled geotextile tubes have been used recently on the Chesapeake Bay shoreline at various locations and were considered for use in the early stages of this study. One such area where they have been used recently is located immediately west of Rhodes Point, where geotextile tubes have been placed to form a continuous breakwater. Although in general, the placement of the geotextile tubes has been beneficial in terms of retarding the shoreline erosion, the results have not been consistent. The present life expectancy of the structures based on recent experience can only be considered to be about five years. The local sponsor has voiced opposition to the use of geotextile tubes in lieu of stone breakwaters other than as a stop gap measure. In addition, experience has shown that sand is best suited to fill the geotextile tubes. Adequate amounts of sand from the dredged material used to fill the geotextile tubes is in short supply and would be better suited for use as fill material behind any protective structures. For these reasons, geotextile tubes were dropped from further consideration.

Table 4.2: Breakwater Configuration Alternatives

Alternative Description	Environmental Considerations	Engineering Effectiveness	Costs	Constructability
Low, nearshore, continuous sill	protects from loss of existing wetland shoreline	Allows frequent overtopping	Follows alignment of shoreline, therefore high material quantities	Difficult to construct due to shallow water access
Low, nearshore, intermittent	loss of wetland shoreline adjacent to gaps	Allows frequent overtopping; areas of unprotected shoreline	lower material quantities than sill	Difficult to construct due to shallow water access
Low, offshore, continuous sill	mudflats in lee of structure	Allows frequent overtopping	greater quantities than nearshore counterpart due to increase in water depth	Easy, allows for barge construction
Low, offshore, intermittent	less potential for loss of wetland shoreline adjacent to gaps than nearshore	Allows frequent overtopping; areas of unprotected shoreline	greater quantities than nearshore counterpart due to increase in water depth	Easy, allows for barge construction
High, nearshore, continuous sill	protects from loss of existing wetland shoreline	Allows less frequent overtopping	greater cost than low height counterpart	Difficult to construct due to shallow water access
High, nearshore, intermittent	loss of wetland shoreline adjacent to gaps	Allows less frequent overtopping; areas of unprotected shoreline	greater cost than low height counterpart	Difficult to construct due to shallow water access
High, offshore, continuous sill	mudflats in lee of structure	Allows less frequent overtopping	greater cost than low height and nearshore counterparts	Allows for barge construction
High, offshore, intermittent	less potential for loss of wetland shoreline adjacent to gaps	Allows less frequent overtopping than nearshore	greater cost than low height and nearshore counterparts	Allows for barge construction

4.3.2.i <u>Summary</u>. For the reasons stated above, only breakwaters and sills were considered viable alternatives to protect and restore the habitat resources at Smith Island. Breakwaters can be constructed from various materials. However, due to the magnitude of the area to be protected, the high energy of waves and currents in the area, the uncertainty associated with the performance of proprietary/unconventional structures, and local sponsor concerns, the use of stone breakwaters and sills were considered the only viable alternatives to address the erosion problems. In addition, artificial beach nourishment and wetland habitat development can be viable alternatives when used in conjunction with structures such as breakwaters and were given further consideration in this context. The configuration of the breakwaters is discussed in detail in Appendix E, and is considered in the plan formulation and evaluation process. Although the primary purpose of the project alternatives is to protect and restore SAV, it is necessary and desirable to protect the marshy landmasses of Smith Island as well. Projects could be developed to protect SAV and not protect the marsh, but this would be more expensive to construct and less beneficial to the overall health of the Smith Island ecosystem.

4.3.3 Western Shoreline/Big Thorofare

There were 14 primary alternatives identified for shoreline protection on the Western Shoreline of the island that were designed to protect and restore the abundant habitat of Big Thorofare, including the no-action alternative and breach repair (see Table 4.3). Each of the alternatives will reduce or eliminate erosion of the emergent wetlands on the Western Shoreline, and will, therefore, protect and restore SAV beds in Big Thorofare. The criteria used to develop the alternatives, and their effectiveness, are shown below. They include structure type, length, distance from shore, and backfill for marsh creation.

- *Structure Type*: Two alternatives were found to be effective as discussed in Section 4.3.1: A continuous low-profile stone sill or a series of off-shore, segmented, stone breakwaters.
- *Length*: Two project lengths were proposed; partial length--extending 6,540 ft. from Swan Island to the northernmost breach or tie-in to the Martin National Wildlife Refuge mainland, and full length—extending 9,840 ft. from Swan Island to the tip of Fog Point Cove. The partial-length is less expensive due to the smaller size, and for the near-term would be equally effective in protecting Big Thorofare. The full-length, however, will protect against breaching that would eventually endanger Big Thorofare, and offers the added benefit of protecting large areas of emergent wetlands from future erosion.
- *Distance offshore*: Proposed alternatives were developed to be 100 ft. offshore and 30 ft. offshore. The distance from the shoreline provides differing levels of protection, wetland creation, construction access, cost, and impact. The distances were considered to be rough estimates since the rough coastline of the Refuge prohibits construction to such a strict tolerance.
- *Backfill*: Backfill was proposed to create additional wetlands and tie the structures to the existing shoreline. Alternatives were developed with and without backfill. Backfill behind the structures would serve two primary purposes. First, the added land would provide valuable wetlands habitat and a buffer in case the structures promote some minor erosion before establishing a stable equilibrium. Second, due to the strong currents in the area, added land that physically connects the structures to the existing shoreline would interrupt the existing longshore transport and would greatly increase the success probability of any

project. This is especially true for breakwaters, which allow more water flow behind them than sills. For these reasons, breakwater alternatives were only considered with backfill, though sill projects were considered with and without. This is shown in Table 4.3. Those alternatives with projected effectiveness ratings of very low or low were not considered further.

The alternatives were formulated to address the high-energy environment and prevent extensive erosion. The no-action plan and breach repair, that is, the minimum action necessary to protect the SAV, were both developed and considered. However, neither option presents a satisfactory solution to the problems identified at Smith Island. The minimum action, breach repair, is likely to lead to additional breaches in other areas and is not expected to be a long-term solution. Thus, breach repair was removed from further analysis. The no-action plan would not address the study goal or objectives. The no-action alternative remains as the basis for initial comparison of alternatives. If, in fact, no plan could be formulated that provided a cost-effective improvement over the no-action plan, then this study would recommend no project implementation. As discussed above, the alternatives with offshore breakwaters and no backfill were also dropped from consideration (also see Appendix C).

Table 4.3: Western Shoreline Plan Alternatives

Number	Alternative Description	Length	Distance Offshore	Preliminary Estimated Cost	Projected Effectiveness
SI1	No-Action	0	0	$ -	Very Low
SI2	Breach Repair	200 ft	-	**$ -**	Very Low
SI3	Continuous sill	6,540 ft.	30 ft.	$2,185,508	Low
SI4	Continuous sill with wetland creation	6,540 ft.	30 ft.	$2,498,511	Moderate
SI5	Continuous sill	6,540 ft.	100 ft.	$2,665,690	Low
SI6	Continuous sill with wetland creation	6,540 ft.	100 ft.	$3,108,066	Moderate
SI7	Continuous sill	9,840 ft.	30 ft.	$3,550,780	Moderate
SI8	Continuous sill with wetland creation	9,840 ft.	30 ft.	$3,881,601	High
SI9	Continuous sill	9,840 ft.	100 ft.	$4,335,070	Moderate
SI10	Continuous sill with wetland creation	9,840 ft.	100 ft.	$4,880,018	High
SI11	Breakwaters	6,540 ft.	100 ft.	$2,345,000	Very Low
SI12	Breakwaters with wetland creation	6,540 ft.	100 ft.	$2,765,000	Moderate
SI13	Breakwaters	9,840 ft.	100 ft.	$3,123,000	Very Low
SI14	Breakwaters with wetland creation	9,840 ft.	100 ft.	$3,660,000	High
SI15	Breakwaters	6,540 ft.	30 ft.	$1,870,000	Very Low
SI16	Breakwaters with wetland creation	6,540 ft.	30 ft.	$2,190,000	Moderate
SI17	Breakwaters	9,840 ft.	30 ft.	$2,480,000	Low
SI18	Breakwaters with wetland creation	9,840 ft.	30 ft.	$2,805,000	High

The two structural techniques determined to be sufficient, as discussed previously, were both designed during the study process to provide maximum protection and minimize environmental and socio-economic impacts. The first structure is a low-profile continuous stone sill built parallel to the shoreline and extending from the Bay floor to a height of +3.5 ft. mean lower low water (MLLW). The height was calculated based on the wave climate of the area and project purpose, includes 0.5 ft of overbuild to account for settlement, and is discussed further in Appendix E. The structure would provide maximum protection from the wave energy by creating an offshore ring surrounding the marsh. The effectiveness of these structures can be increased with the use of backfill to create stable marshland behind them. Offshore, segmented breakwaters are similar to a sill, except that they are not continuous structures, with 150-ft. gaps between each individual breakwater. Although breakwaters provide less complete protection, they help preserve the natural shoreline and the marsh hydrology, by allowing continued interaction between the Bay and the marsh. When used in conjunction with stabilized (planted with native marsh vegetation) backfill, breakwaters can be as effective as sills.

Two different alternative lengths were developed. The partial length alternative is considered the minimum length necessary to protect Big Thorofare, by repairing the existing breaches and preventing additional breaching in the remaining marsh. The full-length alternative provides additional protection to the marsh and prevents flanking of the protection from concentrated erosion north of the structure. In addition, the full-length alternatives tie this project to the Fog Point Cove project, thereby improving the likelihood of success for that project and providing the maximum protection along the Western Shoreline.

Two distances from the shoreline were initially considered. The near-shore alternative is located approximately 30 ft. offshore, in the shallow water near the marsh. This alternative will reduce the amount of stone necessary due to the shallow depths, but make construction more difficult since barge-based construction may not be possible. The second alternative, a structure located 100 ft. off-shore, would provide easier construction access and a larger area behind the structure, although it is expected to cost more and may not be as effective at erosion protection.

Finally, alternatives were developed with and without backfill for wetland creation. The use of backfill requires borrow material that would likely be dredged from the Bay floor, but would provide additional wetland functions and increase the effectiveness, and likelihood of success of the structures.

Some of the above alternatives are shown in the following concept maps, Figures 4.2 to 4.6. The alternatives will be analyzed in Section 4.4 according to their cost effectiveness, engineering viability, and environmental and socio-economic impact.

Figure 4.2: Western Shoreline Alternatives SI2 through SI5

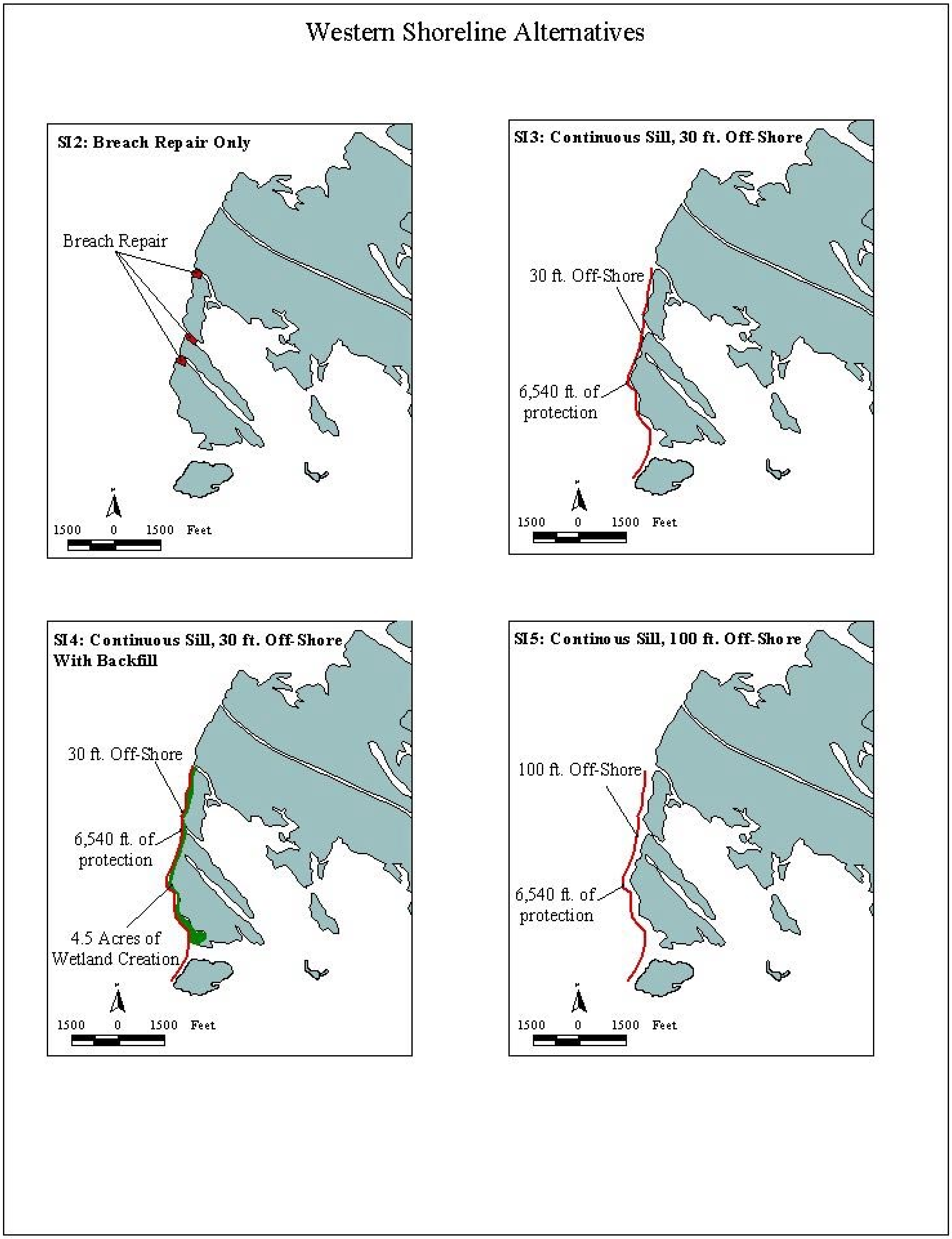


Figure 4.3: Western Shoreline Alternatives SI6 through SI9

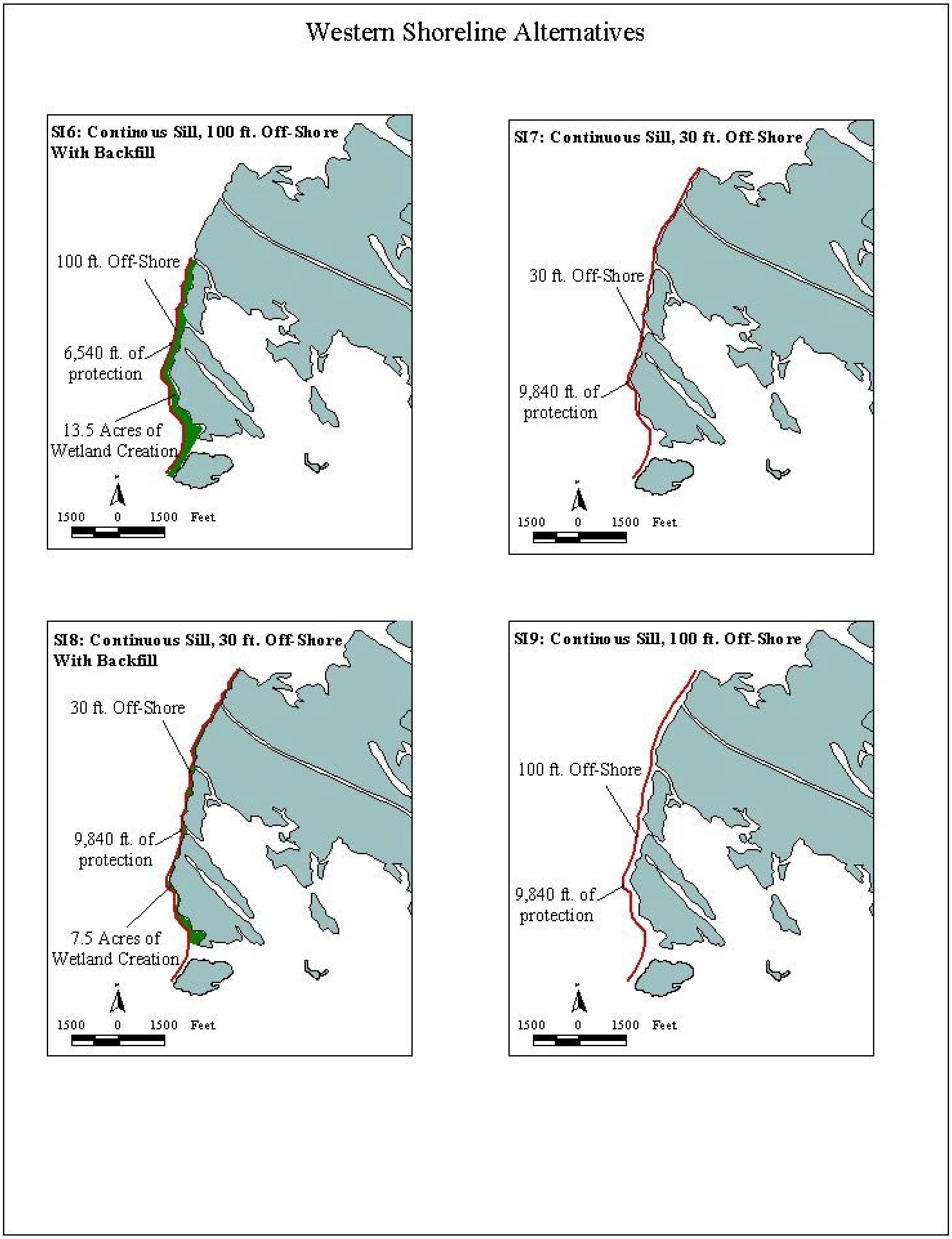


Figure 4.4: Western Shoreline Alternatives SI10 through SI13

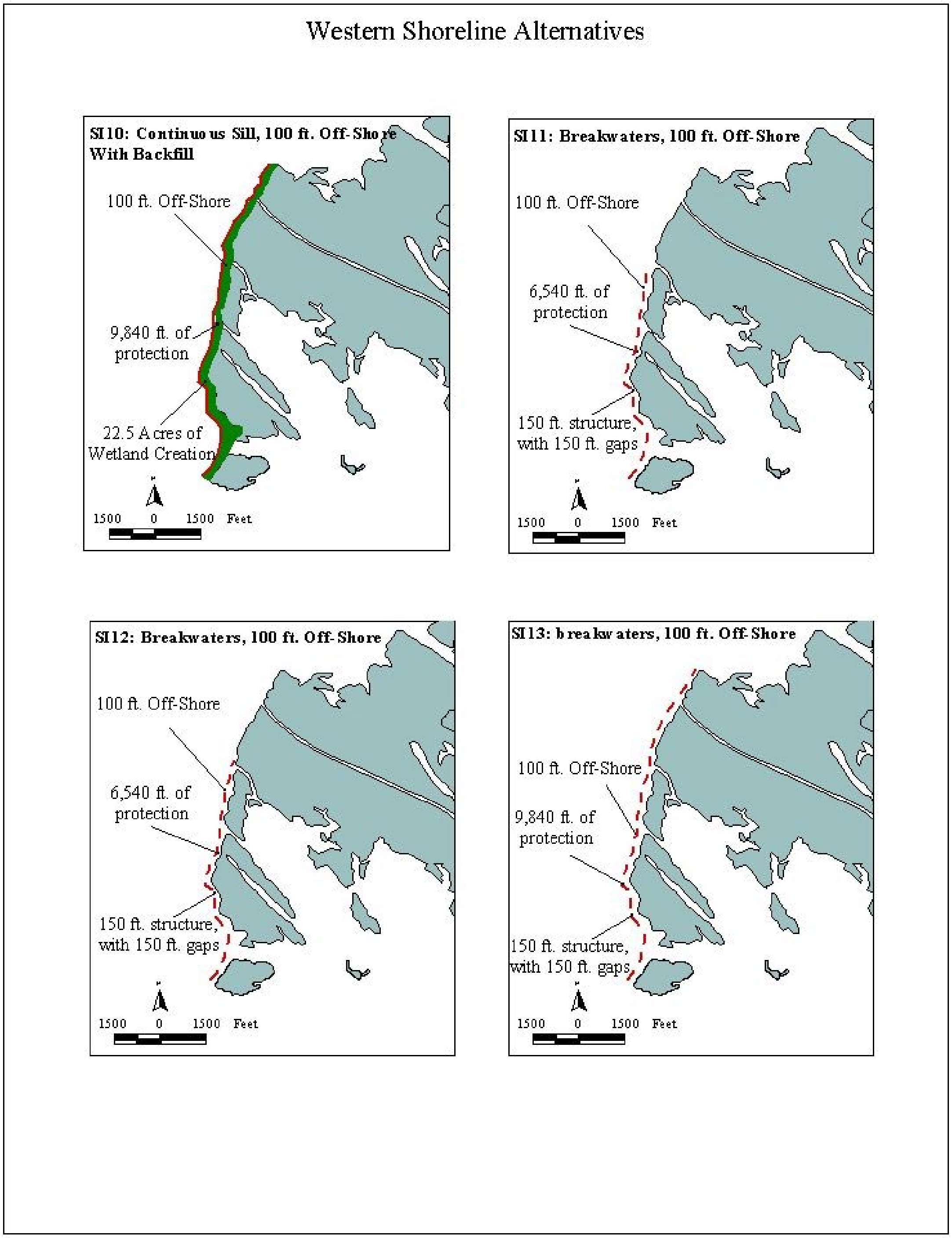


Figure 4.5: Western Shoreline Alternative SI14-17

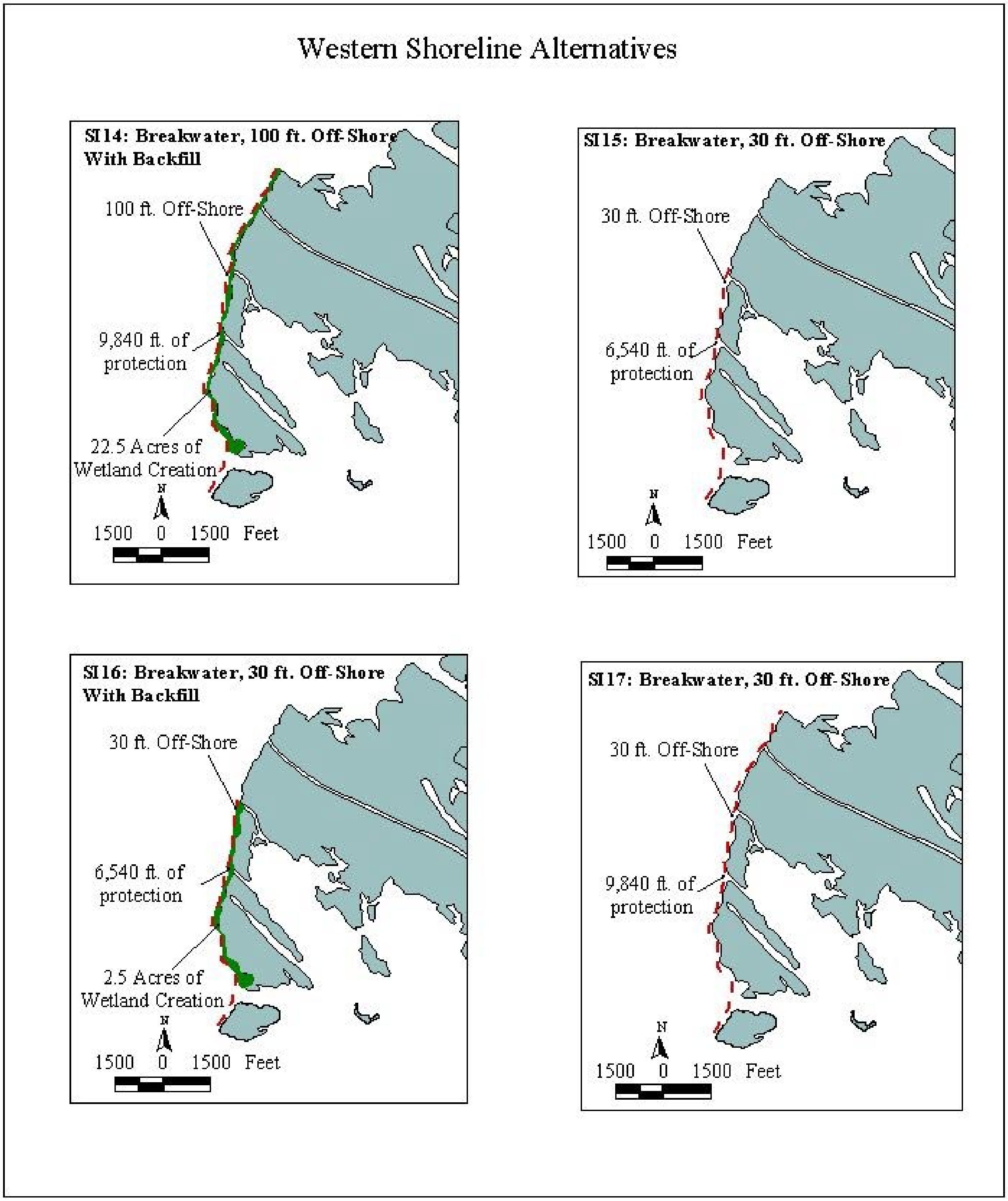
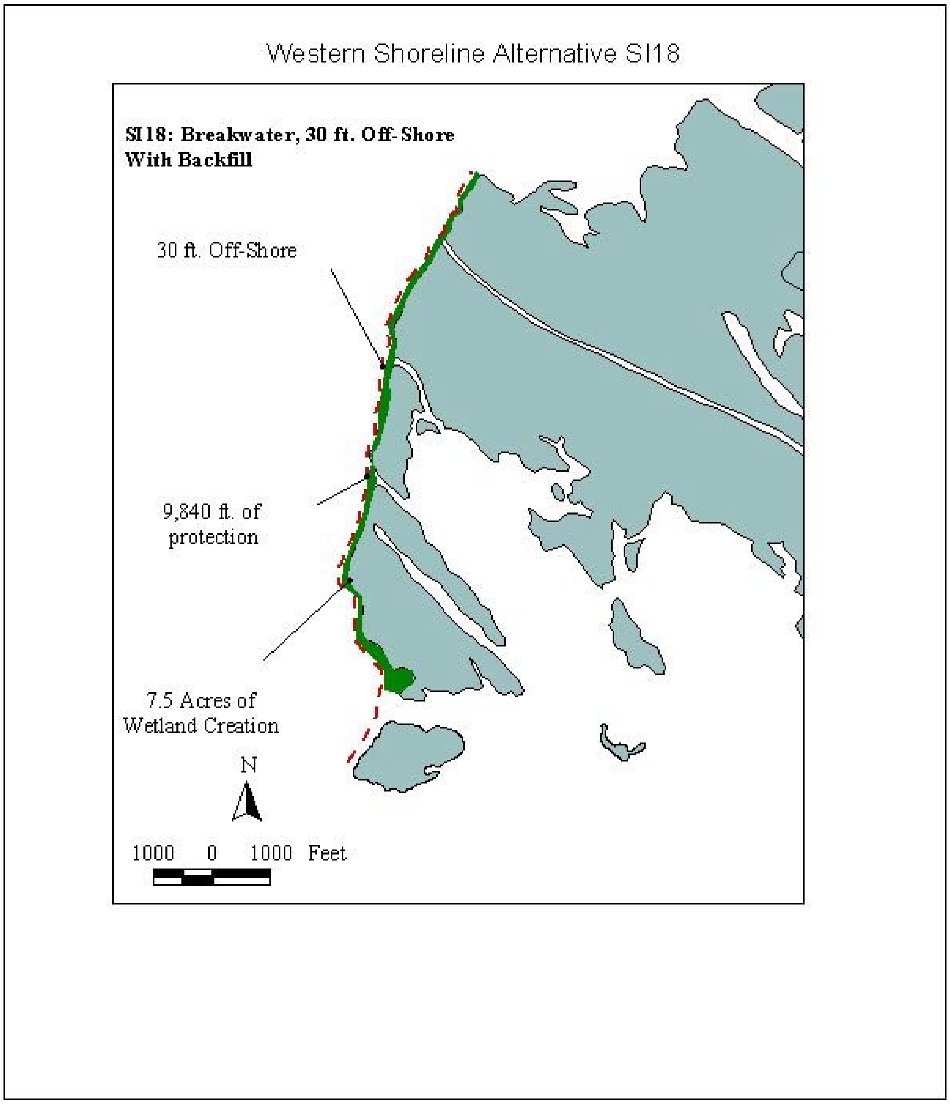


Figure 4.6: Western Shoreline Alternative SI18



4.3.4 Fog Point Cove

There were nine primary alternatives identified for the protection and restoration of SAV at the Fog Point Cove area, including the no-action alternative. As with the Western Shoreline alternatives in Section 4.3.2, all the alternatives are to be compared initially with the no-action plan to determine if they are justified for further analysis. Table 4.4 presents the alternatives.

These alternatives were generated by varying the following parameters: the two accepted structural methods, the use of backfill, and which shoreline is to be protected (that is, the eastern or western side of the cove). These parameters are discussed further below.

- *Structural Method*: The conditions at Fog Point Cove are similar to the western shoreline, with considerable wave energy and active erosion. Again, two structural techniques were determined to be viable, the low profile stone sill and the offshore segmented breakwaters. These structures provide the protection necessary under high-energy conditions. Since the purpose of the Fog Point Cove west shoreline structure is to recreate a peninsula, the segmented breakwaters were not considered. Either a sill or breakwaters are appropriate for the eastern shoreline structure.
- *Backfill*: Backfill for wetland creation was considered to generate additional wetland benefits and increase the effectiveness of the plan. The backfill for Fog Point Cove is not as critical for the alternatives as it was for the Western Shoreline since the structures at Fog Point are designed to recreate lost spits of land. Longshore transport is not an issue. The created land and sandy beaches, however, would create extremely valuable diamondback terrapin habitat and would have a positive effect on project effectiveness.
- *Shoreline*: Alternatives were formulated using the western shoreline, the eastern shoreline, or both shorelines. Structures at either shoreline are expected to reduce erosion and protect the cove. Structures on the eastern shoreline are not anticipated to realize any created SAV unless the western shoreline project is also constructed. Therefore, alternatives for the eastern shoreline are considered only as additive components of the western shoreline plans. This is reflected in Table 4.4, which shows low effectiveness for the eastern-shore only plans. Only alternatives rated as moderate or better were considered further.

The Fog Point Cove alternatives are shown in Figures 4.7 through 4.8. Each is analyzed in Section 4.4 according to its cost effectiveness, engineering feasibility, and environmental impact.

Table 4.4: Fog Point Cove Plan Alternatives

Number	Alternative Description	Shoreline Protected	Length of Protection	Preliminary Estimated Cost	Effectiveness
FP1	no action	None	0	**$ -**	Very Low
FP2	sill	Western	600 ft.	$ 375,527	Moderate
FP3	sill/backfill	Western	600 ft.	$ 789,159	Moderate
FP4	sill	Eastern	1,200 ft	$ 709,203	Low
FP5	sill/backfill	Eastern	1,200 ft	$1,047,957	Low
FP6	breakwaters	Eastern	1,200 ft.	$ 336,200	Low
FP7	sill	both shorelines	1,800 ft.	$1,498,362	Moderate
FP8	sill/breakwaters	both shorelines	1,800 ft.	$ 711,727	High
FP9	sill/breakwaters--with backfill	both shorelines	1,800 ft.	$1,125,359	Very High

Figure 4.7: Fog Point Alternative FP2 through FP7

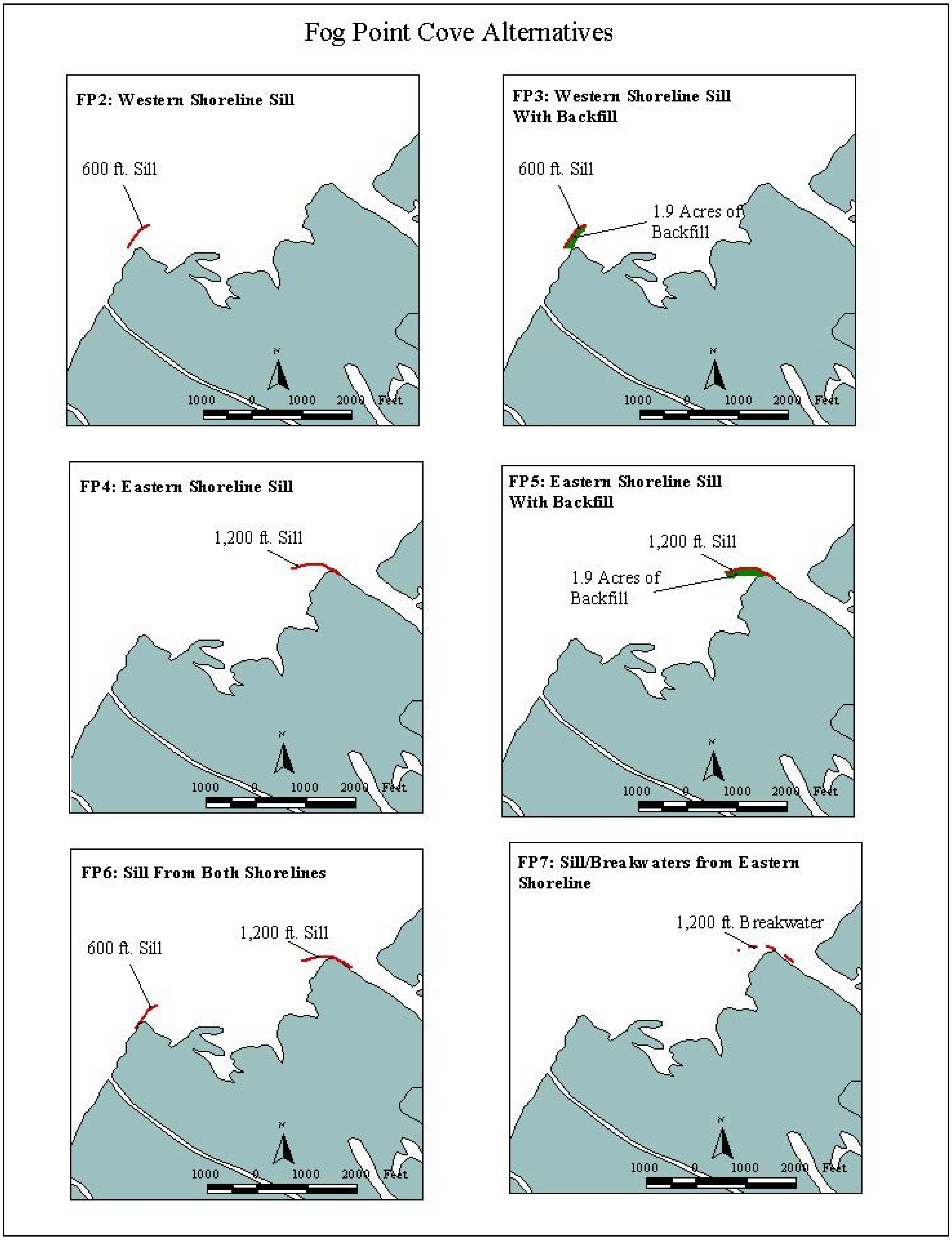
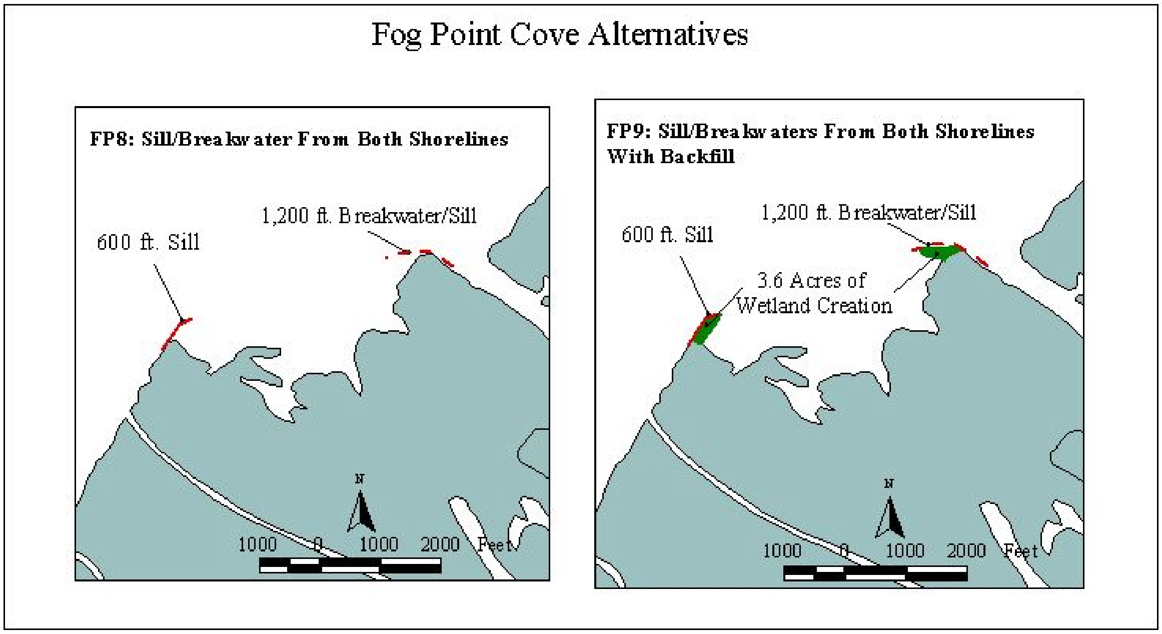


Figure 4.8: Fog Point Alternatives FP8 and FP9



4.3.5 Back Cove

The Back Cove project site was divided into two separate areas, the northwestern shoreline and the southeastern shoreline, with eight different alternatives developed for the northwestern shoreline, and nine developed for the southeastern shoreline. The alternatives were developed using the following parameters: shoreline protected, structure type, with or without an extension, and with or without backfill. The parameters are discussed below.

- *Shoreline*: In order to protect Back Cove, it was determined that the protection of the marsh protecting the cove was necessary to maintain its integrity. The northwestern shoreline is currently being breached, exposing the interior of the cove to increased wave energy and sedimentation. The southeastern shoreline is a narrow stretch of marsh that provides the physical structure for both Back Cove and Terrapin Sand Cove, which make it an important area to protect.
- *Structure Type*: Again, because of the high wave energy within the area, two erosion protection techniques were determined to be feasible, a continuous low-profile stone sill, or a system of offshore segmented breakwaters.
- *Extension*: The protecting peninsula at the northwest of Back Cove has eroded considerably, providing more direct wave exposure and adding sediment to the water column. An alternative containing an extension of the existing marsh, to restore the peninsula to its more natural extent was developed. The extension would cut wave energy and restore the shape of the cove. A similar alternative was developed for the southeastern shoreline to add shallow-water protection.

- *Backfill*: Backfill for wetland creation was also analyzed to generate additional wetland benefits and increase the effectiveness of the projects. Backfill behind breakwater protection along existing shoreline was considered to be critical for the reasons discussed in Section 4.3.3. Backfill behind the extensions provides excellent habitat creation potential, but is less important for the overall success of the plans. Breakwater alternatives without backfill were not considered due to questionable effectiveness.

The plan alternatives are shown in Table 4.5 (northwest shoreline alternatives) and 4.6 (southeast shoreline alternatives). Alternatives with a low or very low effectiveness rating were not analyzed further. The alternatives listed are shown in concept drawings, Figures 4.9 through 4.11.

Table 4.5: Northwest Shoreline

Number	Alternative Description	Shoreline	Length of Protection	Preliminary Estimated Cost	Effectiveness
BC1	no-action	Northwest	0	$ 0	Very Low
BC2	sill	Northwest	5,200 ft	$ 2,557,000	Moderate
BC3	sill/backfill	Northwest	5,200 ft	$ 2,861,000	High
BC4	sill/extension	Northwest	5,950 ft	$ 2,918,000	Moderate
BC5	sill/extension--backfill	Northwest	5,950 ft	$ 3,236,000	High
BC6	breakwaters	Northwest	5,200 ft.	$ 1,569,000	Low
BC7	breakwaters/extension	Northwest	5,950 ft	$ 2,043,000	Low
BC8	breakwaters/extension--backfill	Northwest	5,950 ft	$ 2,343,000	High

Table 4.6: Southeast Shoreline

Number	Alternative Description	Shoreline	Length of Protection	Preliminary Estimated Cost	Effectiveness
BC9	no-action	Southeast	0	$ 0	Very Low
BC10	sill	Southeast	1,950 ft	$ 1,045,000	Moderate
BC10a	sill with extension	Southeast	2,950 ft	$ 3,306,000	Moderate
BC11	sill--backfill	Southeast	1,950 ft	$ 1,415,000	High
BC11a	sill/extension --backfill	Southeast	2,950 ft	$ 4,056,000	High
BC12	breakwaters	Southeast	1,950 ft	$ 784,000	Low
BC12a	breakwaters/extension	Southeast	2,950 ft	$ 1,009,000	Low
BC13	breakwaters--backfill	Southeast	1,950 ft	$ 1,144,000	High
BC13a	breakwaters/extension--backfill	Southeast	2,950 ft	$ 1,759,000	High

Figure 4.9 Back Cove Alternatives BC 2 through BC 7

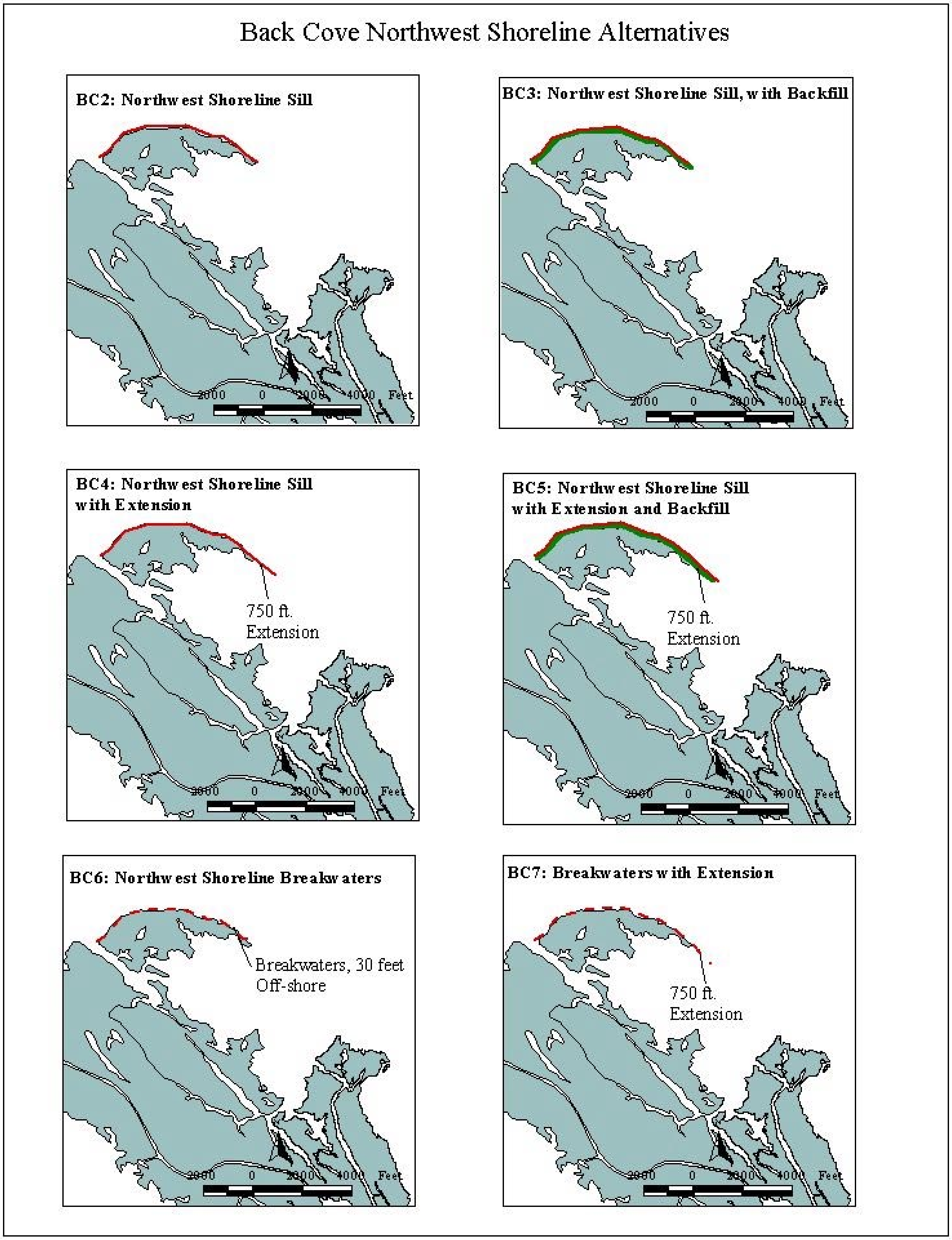


Figure 4.10 Back Cove Alternatives BC 8 through BC 10a

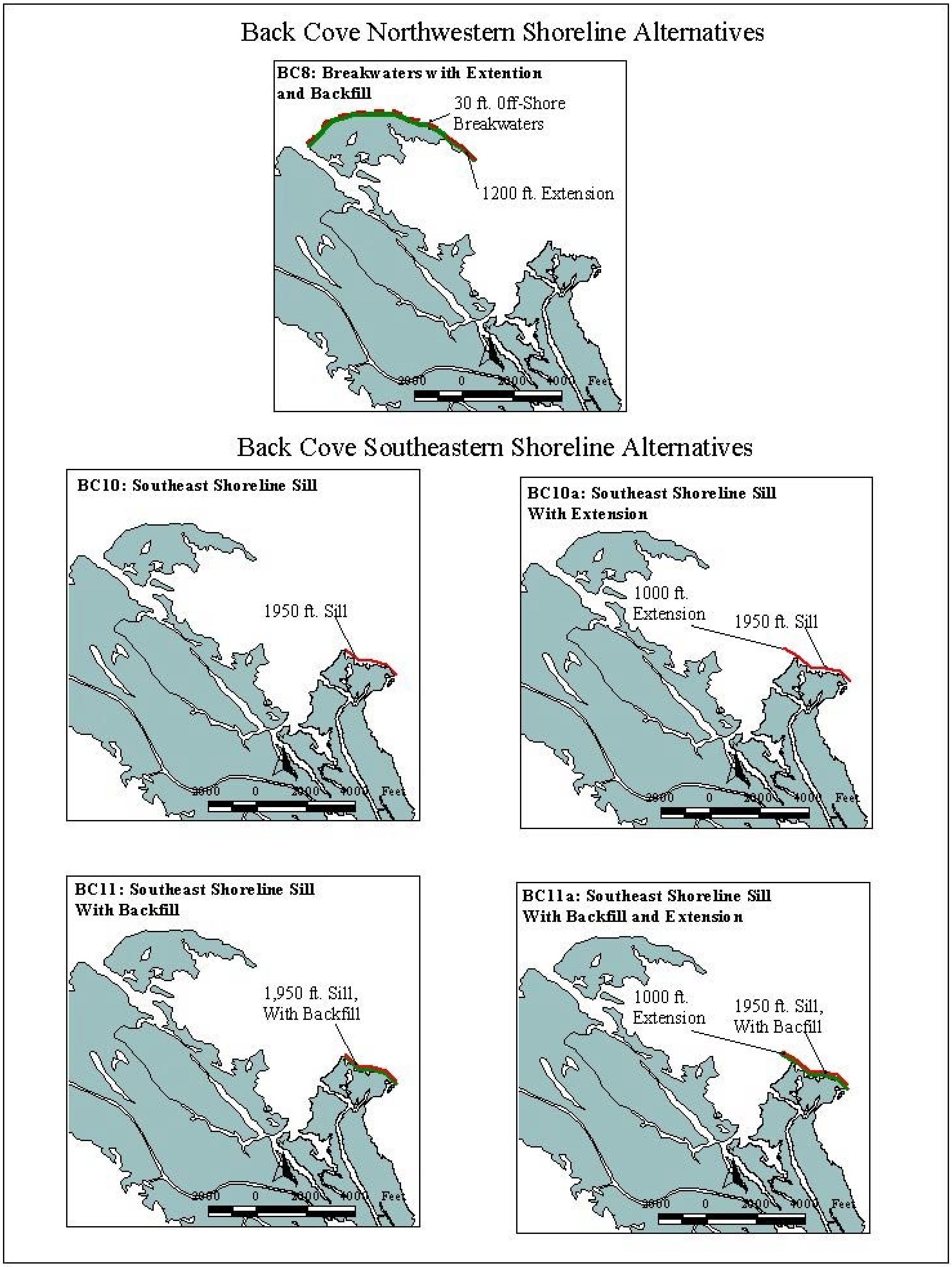
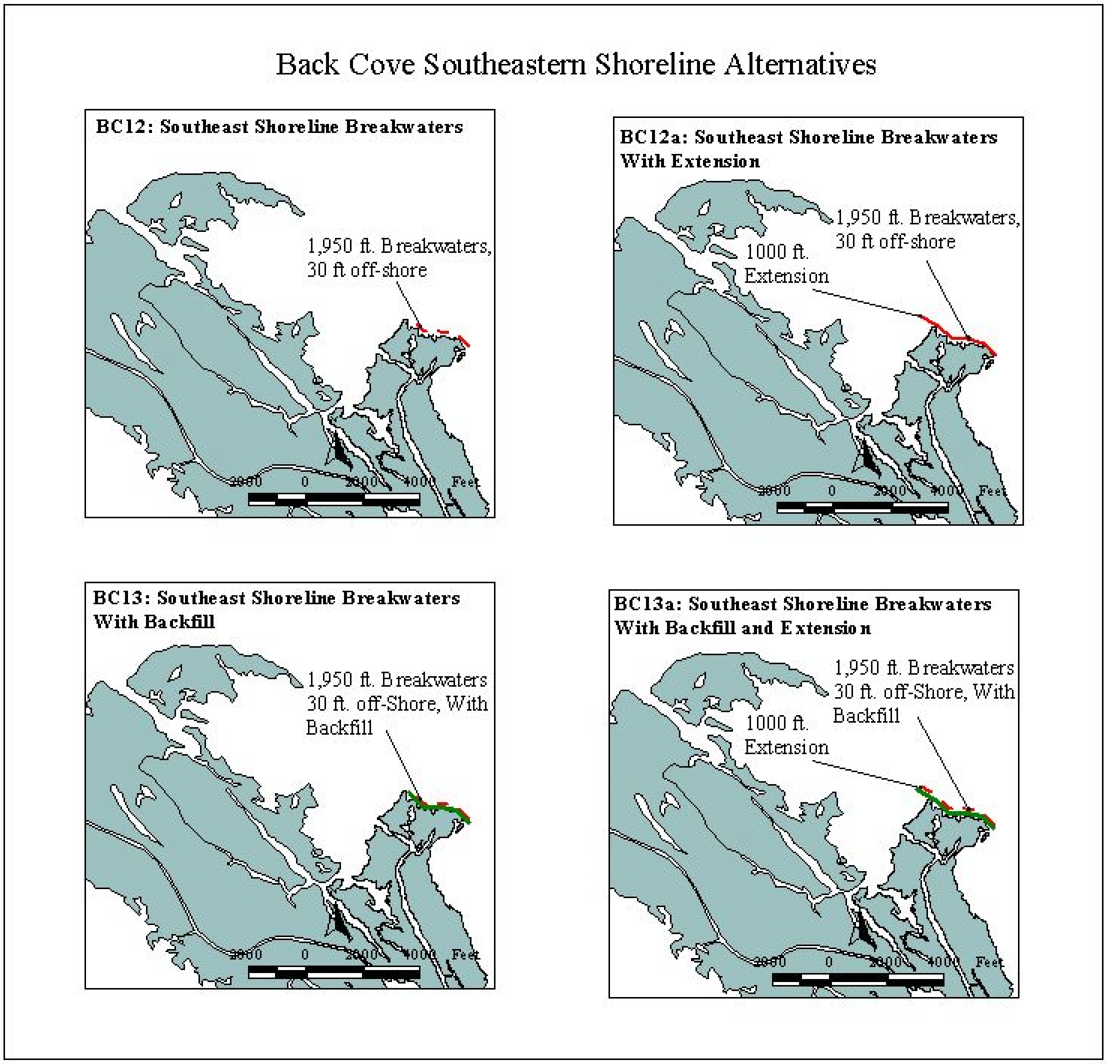


Figure 4.11: Back Cove Alternatives BC12 through BC 13a



4.3.6 Terrapin Sand Cove

There were five alternatives formulated for protection of the shoreline of Terrapin Sand Cove, including the no-action alternative. Terrapin Sand Cove is highly degraded and is in danger of losing its physical structure as a cove. For this reason, the alternatives were developed to repair the physical structure, restoring the quiescent water and protecting the interior. The alternatives were developed in terms of structure type and the presence or absence of an extension. The base plans include a structure from the mainland of the Refuge to the remnant islands to the southeast. These islands are the last remains of the protective peninsula that once formed the cove. The extension is a structure that extends from the remnant islands to deeper water along the same general line as the first structure in order to create a larger protected cove area. These criteria are discussed below:

- *Structure Type*: because of the high wave energy within the area, two erosion protection techniques were determined to be feasible, a continuous low-profile stone sill, or a system of offshore segmented breakwaters.
- *Extension*: The extension is designed to restore the cove to its historic condition. Terrapin Sand Cove originally had a protecting peninsula extending south towards Barnes Cove. This peninsula has completely degraded and alternatives were formulated to reconstruct this peninsula, repairing the physical structure of the cove. The length of the proposed extension (2,600 ft.) was determined by, and limited by, the bathymetry in the area.

The alternatives devised by the study team are listed in Table 4.7 and are shown in Figure 4.12. Backfill for wetland creation is not feasible at Terrapin Sand Cove due to the cost involved, and is therefore not addressed in the concept plans. Also, backfill is not required to assure project success.

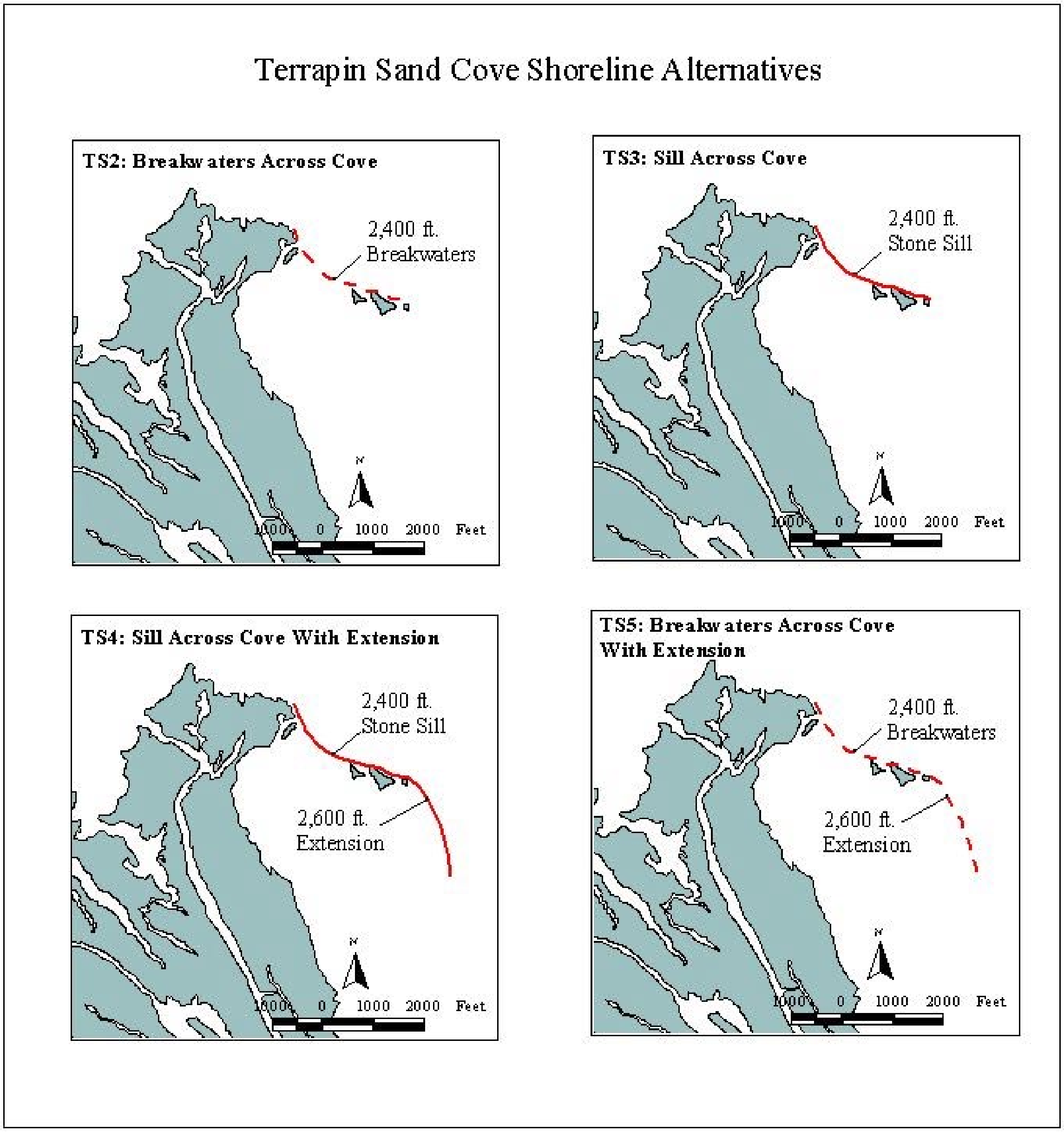
Table 4.7: Terrapin Sand Cove Alternatives

Number	Alternative Description	Length	Preliminary Estimated Cost	Effectiveness
TS1	no-action	0 ft.	$ -	Very Low
TS2	Breakwaters	2,400 ft.	$ 18,356,000	Moderate
TS3	Sill	2,400 ft.	$ 30,287,400	Moderate
TS4	sill/extension	5,000 ft.	$ 42,267,000	Moderate
TS5	Breakwaters/extension	5,000 ft.	$ 30,336,000	Moderate

4.4 EVALUATION AND COMPARISON OF ALTERNATIVES

The alternatives identified by the study team and described in Section 4.3 were analyzed to determine the best alternatives for each project area. The plans were compared on the basis of habitat protected and habitat created. For this analysis, the habitats considered were wetlands and SAV. Other habitats, such as natural shoreline, mudflats, shallow-water, and the like are discussed in Section 5 after the feasibility study recommendation is determined. The study team concluded that to compare outputs based on acreage of SAV, for example, would also yield a project to benefit shallow-water habitat and mudflats, since the requirements are similar. These benefits must be considered, however, in order to completely analyze the anticipated future with-project condition. A discussion of the formulation and alternatives analysis process is presented in Sections 4.4.3, 4.4.4, 4.4.5, and 4.4.6.

Figure 4.12: Terrapin Sand Cove Alternatives



4.4.1 Fill Material Sources

The fill material for wetland creation can be obtained from a number of sources: dredged material sites, upland areas, commercial sources, or borrow areas.

4.4.1.a Dredged Material Sites. USACE has developed a number of beneficial use of dredged material projects in the Chesapeake Bay. These projects include the Kingman Lake Wetland Restoration, the Eastern Neck Restoration, and the Hog Neck Restoration Project (located just south of Rhodes Point). Typical beneficial use projects include wetland creation, shoreline protection, or both. The Hog Neck Restoration used dredged material from Big

Thorofare to fill geotexile tubes for shoreline protection and used additional material for backfill. The project was successful in terms of reducing erosion and creating wetlands. However, a number of geotextile tubes were damaged, necessitating repair in future dredging cycles. The lessons learned from the Hog Neck Restoration have been incorporated into the plan formulation for this project.

For planning purposes, approximately 115,000 cubic yards of fill material was estimated to be required for wetland creation at the three project components (though subsequent analyses show that less will likely be needed). To be successful, the material must be fine sand or coarser. Fine sediments, such as silt, are too unstable for unconfined placement and would not be acceptable behind a breakwater or sill structure.

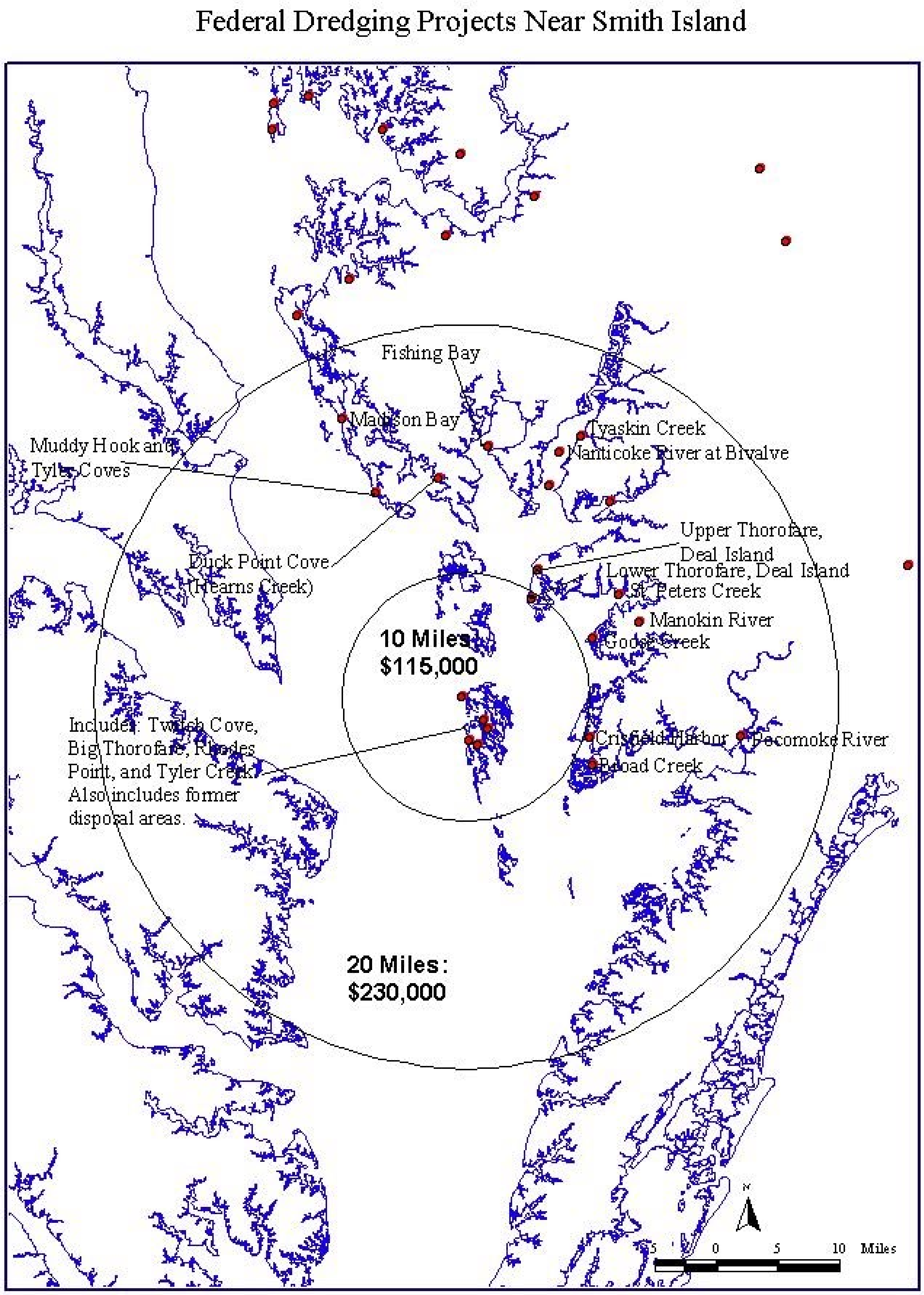
The feasibility of using nearby channels for backfill was explored. Because of the high cost of transportation, only channels within twenty miles of Smith Island were considered. These sites are shown in Figure 4.13. The transportation cost is a major factor and is calculated at $0.10 per cubic yard, per mile. Thus, costs at ten miles were $115,000 and costs at twenty miles were estimated at $230,000. The sites shown in Figure 4.13 will be screened for several factors during pre-construction, engineering and design (PED): material particle size, material quantity, and material availability. At present, due to problems of maintenance scheduling, it is difficult to plan for the use of future dredged material. Maintenance activities are traditionally scheduled only a year or two in advance, while backfill activities on this project are targeted for two to four years in the future. During PED, as the construction schedule is developed, dredged material sites will be revisited. The use of materials from existing placement sites is difficult and expensive since getting the material from upland to a barge may require dredging an access channel for the barge. For all these reasons, and although this issue will be studied in greater depth during PED, it is likely that the preferred material sources will be adjacent to the project component areas as discussed below.

4.4.1.b Borrow Sites. As discussed in the previous section, plan alternatives will be considered with material placed in the lee of the structures (backfill) in order to create additional habitat and to enhance the performance of the plans. Based on the investigations completed, several potential offshore borrow areas have been identified. During PED phase of study, more borrow investigations may be required depending on the environmental constraints attached to the potential sites identified during this study effort.

The study team identified five sites in the project vicinity to investigate for suitable backfill material. These sites were identified based on proximity to the plan sites, location of oyster bars and other environmental resources such as SAV, water depth so as to avoid shallow-water habitat, and bottom contour. A detailed discussion of the sampling methodology and testing can be found in Appendix E. The following areas were investigated (see Figure 4.14):

1. South of the Big Thorofare Jetties, West of Rhodes Point.
2. North of the Big Thorofare Jetties, West of Swan Island.
3. North of the Martin Wildlife Refuge.
4. East of the Martin Wildlife Refuge.
5. Area around Big Thorofare Channel, East of jetties, near Ewell.

Figure 4.13: Sites Considered for Borrow Material



Area 1 generally consisted of fine sand and silt. The sand ranged in depth from 0.0' – 10.0'+ in this area; however, some borings did not encounter sand at all. Area 1 material could be used for wetland fill if adequately protected from wave action, but it is considered a marginal borrow source candidate.

Area 2 generally consisted of a layer of fine sand ranging in depth from 4 feet to deeper than 10 feet. Several borings, however, recovered only clay. Area 2 material could be used for wetland fill if adequately protected from wave action, and depending on necessary grain size for the potential projects, Area 2 is a borrow source candidate.

Area 3 generally consisted of fine sand, silt, and clay. Areas where sand was found were usually no deeper than 5 feet. Clay was found in many holes, some at the top of the hole, and more typically, 5 feet below ground surface. Area 3 material could be used for wetland fill if adequately protected from wave action, but is considered marginal.

Area 4 generally consisted of fine, sandy silt. It may be considered a suitable borrow source for wetland fill, depending on the fill requirements, but is very marginal.

Area 5 generally consisted of a 2-inch layer of fine sand above at least a 5-foot layer of clay. Thus, due to lack of suitable material, Area 5 has been eliminated from further consideration.

Once a borrow source is chosen, more in-depth investigations of the selected borrow area will be conducted as part of PED studies. A thorough delineation of oyster beds, SAV areas, and other environmentally sensitive features would be required. More accurate estimates on potential borrow quantities would also be made.

The recommendation from this initial borrow exploration is to further explore Area 2 as a potential borrow source. Depending on grain size requirements, Area 1 and Area 3 can also be further explored as potential borrow sources. The material is only suitable for backfilling behind protection structures as discussed previously.

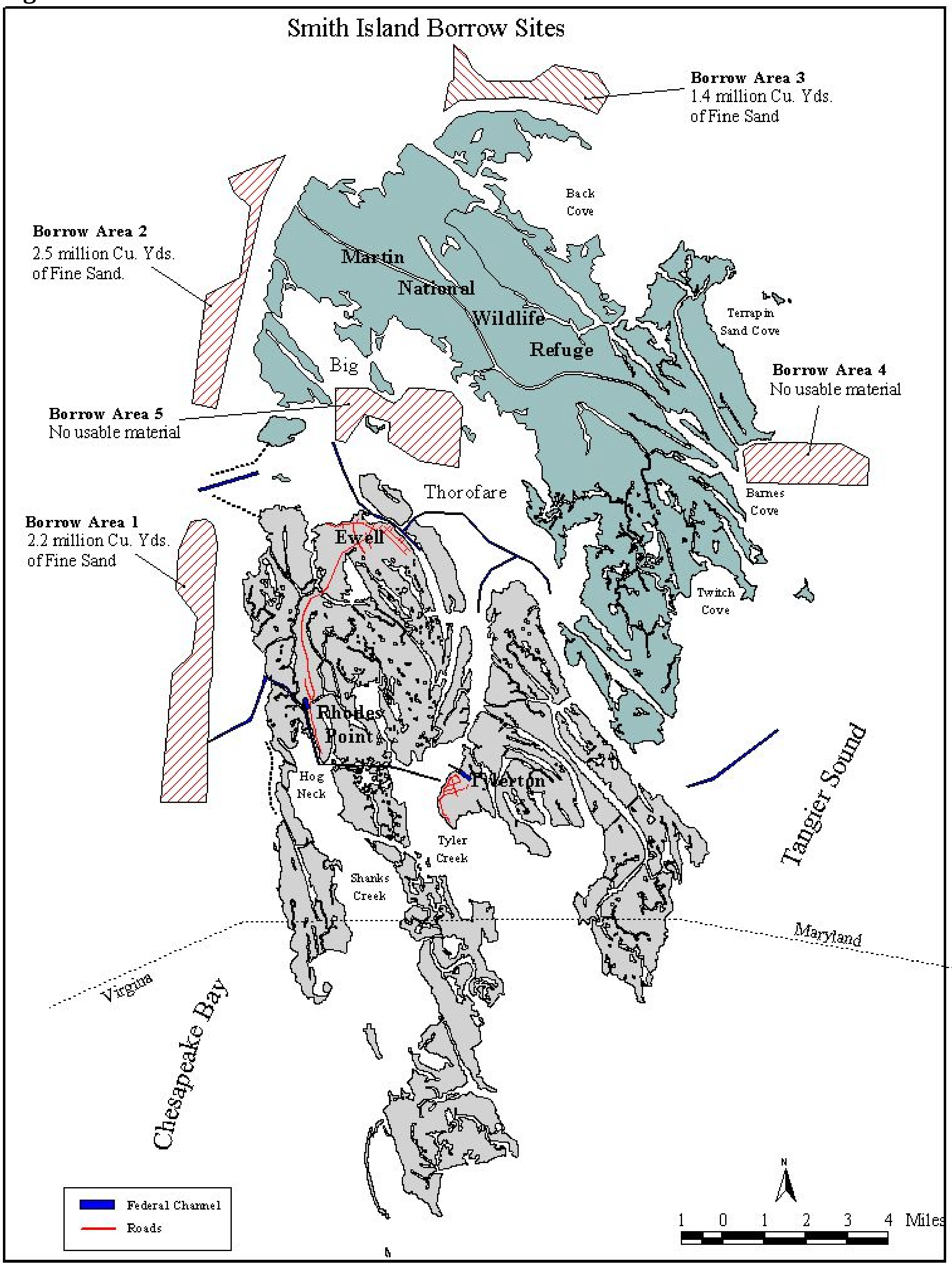
Based on rough planning-level estimates, the following quantities of available material were calculated. It must be indicated that the actual amount of borrow available will depend not only on the volume of suitable material, but also on borrow limitations identified for environmental reasons.

- Area 1 – approximately 2.2 million cubic yards of usable material
- Area 2 – approximately 2.5 million cubic yards of usable material
- Area 3 – approximately 1.4 million cubic yards of usable material

Therefore, up to 4,000 acre-feet of material is potentially available. The estimates were made assuming total removal of all usable material. In reality, the creation of large holes may not be environmentally acceptable. Borrow methods have not yet been determined. Indications are that the availability of suitable material will be a limiting factor in project selection.

Discussions with NMFS were undertaken after the initial borrow investigations regarding potential restrictions that would be imposed to minimize environmental impacts to the Bay bottom. A preference has been made by NMFS to avoid environmental impact for the use of nearshore material. PED investigations will address this request as well as other concerns that arise from public and agency comment on this environmental assessment. The possible impact by the use of nearshore material on the wave climate in the area will be addressed in PED also. Sediment borrow may need to be conducted such that the wave climate does not become more severe and threaten the shoreline further.

Figure 4.14: Location of Potential Borrow Sites



4.4.2 Environmental Restoration and Protection

When the Smith Island Environmental Restoration and Protection feasibility study commenced in 1998, it was anticipated that the final recommendations would include environmental restoration plans as well as navigation improvements and tidal inundation protection. As discussed in previous chapters, the tidal inundation and shoreline protection project for Tylerton was considered and implemented under Section 510 of WRDA 1996. The Rhodes Point small navigation project was considered under Section 107 of the River and Harbor Act of 1960. The remaining alternatives were in the interest of restoring and protecting the environment and the unique ecosystem of Smith Island. Therefore, the plan formulation process for this study consisted of only the project sites discussed in this section. A major component of the justification of these plans is the wetland protection aspect of the study authority as well as erosion control and environmental restoration. Due to the rapid rate of habitat loss at Smith Island, protection of the critical environmental amenities of the island is given high priority. The following sections describe the plan alternatives considered at each site and the anticipated benefits of the actions, including both habitats created and protected.

4.4.3 Western Shoreline/Big Thorofare Alternatives Analysis

4.4.3.a <u>Habitat Protection</u>. As discussed in Section 4.2, the projected wetlands loss over a 50-year period of analysis is expected to be 135 acres along the Western Shoreline. On an annual basis, the loss is 2.7 acres per year. The expected loss of SAV is estimated at 239 acres and would occur in Big Thorofare.

The alternatives defined in Section 4.3 include plans to protect the entire Western Shoreline from Swan Island to Fog Point, and "partial-length" alternatives to protect from Swan Island to the mainland of the Martin National Wildlife Refuge. Of the total potential benefits, the full-length alternatives provide erosion protection to 135 acres of wetlands over the 50-year analysis period. The partial-length alternatives would protect 95 acres of wetlands over the same period. This amounts to a rate of 1.9 acres protected along the shoreline annually.

The partial-length alternatives are expected to provide protection to SAV for only the first 10 years of the 50-year period of analysis. After 10 years, the partial-length alternatives are expected to become less effective due to flanking of the line of protection by erosion. The full-length alternatives, on the other hand, are expected to maintain effectiveness for the entire 50-year project life. The expected SAV protection benefits, for the partial-length alternatives, were calculated based on reasonable expectations of SAV protection during the first 10 years and subsequent losses after 10 years similar to the current condition since 1992. The discounted benefits amount to 118 acres of SAV protected.

The full-length alternatives are expected to protect the existing SAV beds in Big Thorofare over the entire 50-year life of the project; therefore protection of the entire 239 acres of existing SAV in Big Thorofare is anticipated.

4.4.3.b Habitat Creation. The alternatives have all been conceived to provide conditions conducive to the restoration of SAV beds that have been lost over time in Big Thorofare. There were approximately 1,945 acres of SAV habitat surveyed in Big Thorofare in 1992. By 1998, only 239 acres of SAV remained. Since significant breaches in the Western Shoreline occurred in 1994, there has been a 45 percent decline in SAV habitat in Big Thorofare. According to available data, the annual mean SAV habitat in Big Thorofare for the period from 1971 to 1998 was 1,445 acres. The potential amount of restoration has been assumed to be 1,206 acres, which is the difference between the 28-year mean and the current acreage. This assumption was determined to be reasonable since it does not assume that conditions will return to historic levels (i.e. the 1930s) nor even to the recent high of 1992. For the analysis of plan outputs and costs, it was assumed that the acreage of Big Thorofare SAV beds will be restored after project implementation over a 10-year period. This assumption translates to a restoration rate of approximately 120 acres per year of SAV habitat. The full-length alternatives are expected to maintain the restored acreage for the remaining 40 years of the project design life.

The partial-length alternatives are not expected to provide conditions conducive to SAV restoration in Big Thorofare beyond the first 10 years of the 50-year period of analysis due to flanking as discussed previously. After 10 years it is estimated that a gradual decline in SAV in Big Thorofare would occur. To account for the expected decline in restored SAV habitat after the first 10 years, the restored acreages were projected to decline by 20 percent per year starting in year 11 of the analysis until it reaches a point where the restored habitat is lost again. The 20 percent rate is modeled after the average rate of decline in Big Thorofare since the 1994 breach event.

Alternatives have been formulated, both the partial-length and full-length, that would include created wetlands using fill material behind the structures. This analysis includes any stabilized (that is, planted) backfill as created wetlands. The estimated acreage of created wetlands is considered to be a benefit for the entire life of the plan.

4.4.3.c Cost-Effectiveness and Incremental Analyses. Table 4.8 shows the preliminary cost estimates to construct each of the 10 alternatives rated "moderate" or better as far as projected effectiveness in Table 4.3. These preliminary cost estimates do not include contractor mobilization and demobilization costs, contingencies or escalation due to future inflation. The costs also do not include real estate, since the State of Maryland owns the Bay bottom. Any costs incurred for real estate will be minimal and are fully considered in the project cost estimate (Appendix E). These preliminary costs were used as estimates for the cost effectiveness and incremental analyses. The "wetlands protected" column shows an annual value as discussed in Section 4.4.3.a, and the "SAV protected" is a grand total that reoccurs each year. The "wetlands created" column shows the total value that will remain throughout the project life. The "SAV restored" acreage is an annualized figure that discounts, through economic calculations, the total acreage assuming that the maximum coverage is not realized until year 10. This methodology is used throughout the analyses presented in this section.

The alternatives shaded in gray were screened out because there is at least one alternative that produces greater or the same output for the same or less cost. The four alternatives remaining after the cost-effectiveness screening were the partial-length breakwaters (30 ft offshore) with wetland creation (SI16), the partial-length breakwaters (100 ft offshore) with wetland creation alternative (SI12), the full-length breakwaters (30 ft offshore) with wetland creation, (SI18), and the full-length breakwaters (100 ft offshore) with wetland creation alternative (SI14). As the table shows, the outputs range from 535.9 acres to 1165.7 acres, with the annual costs ranging from $146,000 to $244,000.

Table 4.8: Cost Effectiveness Screening of Western Shore Alternatives (Outputs in Acres)

Alternative Description	Wetlands Protected	Wetlands Created	SAV Protected	SAV Restored	Total Output	Cost	Annual Cost
No Action		0	0	0	0	$0	$0
SI4 Partial-length nearshore Sill with wetland creation	1.9	5	118	411	535.9	$2,499,000	$167,000
SI16 Partial-length Breakwaters with wetland creation	1.9	5	118	411	535.9	$2,190,000	$146,000
SI12 Partial-length Breakwaters offshore with wetland creation	1.9	14	118	411	544.9	$2,765,000	$185,000
SI6 Partial-length offshore Sill with wetland creation	1.9	14	118	411	544.9	$3,108,000	$208,000
SI18 Full-length Breakwaters nearshore with wetland creation	2.7	7.5	239	902	1151.2	$2,805,000	$187,000
SI7 Full-length Sill nearshore	2.7	7.5	239	902	1151.2	$3,551,000	$237,000
SI8 Full-length Sill nearshore with wetland creation	2.7	7.5	239	902	1151.2	$3,882,000	$259,000
SI14 Full-length Breakwaters offshore with wetland creation	2.7	22	239	902	1165.7	$3,660,000	$244,000
SI9 Full-length Sill offshore	2.7	22	239	902	1165.7	$4,335,000	$290,000
SI10 Full-length Sill offshore with wetland creation	2.7	22	239	902	1165.7	$4,880,000	$326,000

In Table 4.9, an incremental analysis was performed for the four remaining cost-effective Western Shoreline alternatives. SI16 was evaluated incrementally against the no-action alternative, and SI12 was evaluated incrementally against SI16 and so on. SI16, the nearshore (30 ft) partial-length breakwater with wetland creation alternative produces an incremental output of 535.9 total acres of output in relation to the no-action alternative. The incremental annual cost per acre of output is $272. SI12, the partial-length offshore (100 ft) breakwater with wetland creation alternative produces an incremental output of 9 total acres of output in relation to SI16. The incremental annual cost per acre of output is $4,333. Similarly, SI18, the full-length nearshore (30 ft) breakwaters with wetland creation, produces 606.3 acres more of output that SI12 at only $3.29 per acre. SI14, the full-length offshore (100 ft) breakwater with wetland creation produces 14.5 acres more than SI18 for $3,931 per acre.

Comparison to the no-action alternative (see Table 7 in Appendix C) yields a cost per acre of $162 to $340 for the alternatives. SI18, the full-length breakwater (30 ft offshore) project with created wetlands is the least expensive. SI12, the partial-length breakwater (100 ft offshore) project with created wetlands, is the most expensive. A more detailed analysis is shown in Appendix C.

Table 4.9:Incremental Values for Each Successive Cost Effective Western Shore Alternative (Outputs in Acres)

Alternative Description	Total Output	Cost	Annual Cost	Incr. Cost	Incr. Output	Incr. $ per Acre Output
No Action	0	$0	$0	NA	NA	NA
SI16 Partial-length Breakwaters with wetland creation	535.9	$2,190,000	$146,000	$146,000	535.9	$272
SI12 Partial-length Breakwaters offshore with wetland creation	544.9	$2,765,000	$185,000	$39,000	9	$4,333
SI18 Full-length Breakwaters nearshore with wetland creation	1151.2	$2,805,000	$187,000	$2,000	606.3	$3.29
SI14 Full-length Breakwaters offshore with wetland creation	1165.7	$3,660,000	$244,000	$57,000	14.5	$3,931

4.4.3.d <u>Western Shoreline "Best Buy" Alternative</u>. The results of the cost-effectiveness and incremental analyses indicate that the full-length, 30 ft offshore, breakwater with created wetlands alternative (SI18) is the most productive alternative. In comparison to the no-action alternative, SI18 produces an additional 1151.2 acres of protected and restored habitat at an annual cost of $162 per acre. This cost is $47 per acre less than the annual cost per acre of the next most productive alternative (SI14) still compared to the no-action alternative. Based on the cost-effectiveness and incremental analysis data, the full-length 30 ft offshore breakwater alternative is identified as the "best buy" for the Western Shoreline.

4.4.4 Fog Point Cove Alternatives Analysis

4.4.4.a <u>Habitat Protection</u>. The western shoreline and both-shoreline alternatives are expected to protect existing SAV beds threatened by erosion of the shoreline. The plans designed for the eastern shoreline would not provide protection to SAV since the wave action from the northwest would not be affected. A 1998 survey indicated there were 29 acres of SAV within Fog Point Cove. It is assumed that, other than the eastern shoreline plans, the alternatives will protect all 29 acres for the entire 50-year project life. The no-action plan and the eastern shoreline plans would provide no protection to SAV, and so the 29 acres would eventually be lost.

4.4.4.b <u>Habitat Creation</u>. The western shoreline and both-shoreline alternatives, as designed, are expected to provide conditions conducive to restoration of SAV beds lost over time in Fog Point Cove. According to available data, the peak SAV coverage measured in Fog Point Cove since 1971 was 98 acres in 1992. The loss since 1992 is attributable to many factors including the continued erosion of Fog Point and the corresponding loss of protection and increase in suspended sediment. The annual mean SAV acreage on Fog Point Cove from 1971 to 1998 was 75 acres. The potential restoration is; therefore, 46 acres using the same logic as was used for the Western Shoreline analysis above. For Fog Point Cove, it was assumed that a plan for the western shoreline only would restore 5 acres of SAV, and a plan for both the western and eastern shorelines would restore the full 46 acres. For the analysis of outputs and costs, it was assumed that the Fog Point Cove SAV beds will realize the maximum restoration of SAV over a period of 10 years. The rate of restoration is, therefore, 10 percent of the potential restoration per year, or 0.5 acres per year for the western shoreline plan and 4.6 acres per year for the full plan. Again, the eastern shoreline alternatives would not be expected to lead to SAV creation, unless constructed in conjunction with a western shoreline component. However, if both an eastern and a western shoreline component were constructed together, the benefits in created SAV habitat would exceed the western shoreline only plans, since the total area of protection would be greater.

Alternatives have also been formulated to include wetlands creation using backfill behind the structures. Since the alternatives for the western shoreline include a sill, and are in the form of extensions from the shoreline, wetlands are not required for plan performance. The sandy beach that would likely be formed behind a western shoreline sill, however, would provide outstanding terrapin habitat. Along the eastern shoreline, backfill would be expected to help performance somewhat, and would also add valuable terrapin habitat.

4.4.4.c Cost-Effectiveness and Incremental Analyses. Table 4.10 lists the preliminary cost estimate to construct the alternatives that rated better than "low" in projected effectiveness as shown in Table 4.4. These preliminary cost estimates do not include mobilization and demobilization costs, real estate costs (as discussed in Section 4.4.3.c), contingencies or escalation due to future inflation. These preliminary costs were used as estimates for the cost effectiveness and incremental analysis. Note that the restored SAV acreage total has been discounted to account for the 10 years of recovery before the total restoration is realized.

The alternatives shaded in gray were screened out because there is at least one alternative that produces the same or greater output for the same or less cost. The nearshore sill from the western shoreline of the cove (FP2), the sill on the western shoreline and breakwaters to the east alternative (FP8), and the sill on the western shoreline, breakwaters on the eastern with created wetlands project (FP9) were carried forward to the incremental analysis.

Table 4.10: Cost Effectiveness Screening of Fog Point Cove Alternatives (Outputs in Acres)

Alternative	Wetlands Created	SAV Protected	SAV Restored	Total Output	Cost	Annual Cost
No Action	0	0	0	0	$0	$0
FP2 Sill from western shore	0	29	4	33	$376,000	$25,000
FP3 FP2 with wetland creation	1.3	29	4	34.3	$789,000	$53,000
FP7 Sill from both shorelines	0	29	34	63	$1,498,000	$100,000
FP8 Sill from western shoreline; breakwaters from eastern shoreline	0	29	34	63	$712,000	$48,000
FP9 FP8 + wetland creation	3.8	29	34	66.8	$1,125,000	$75,000

Table 4.11 shows the results of the incremental analysis that was conducted on the three cost-effective alternatives. As compared to the no-action plan, the sill from the western shoreline alternative has an incremental habitat benefit of 33 acres at an incremental cost of $758 per acre. The difference between FP2 and FP8 is 30 acres of habitat at $767 per acre. The difference between FP8 and FP9 is 3.8 acres at $7,105 per acre. See Appendix C for more detail.

Table 4.11: Incremental Values for Each Successive Cost Effective Fog Point Cove Alternative (Outputs in Acres)

Alternative	Total Output	Cost	Annual Cost	Incr. Cost	Incr. Output	$/ Acre of Output
No Action	0	$0	$0	NA	NA	NA
FP2 Sill from western shoreline	33	$376,000	$25,000	$25,000	33	$758
FP8 Sill from western shoreline; breakwaters from eastern shoreline	63	$712,000	$48,000	$23,000	30	$767
FP9 FP8 + wetland creation	66.8	$1,125,000	$75,000	$27,000	3.8	$7,105

4.4.4.d Fog Point Cove "Best Buy" Alternative. The results of the cost-effectiveness analysis indicate that FP2, sill from the western shoreline, is marginally the most productive alternative. In comparison to the no-action alternative, the western shoreline sill alternative produces an additional 33 acres of habitat at an annual cost of $758 per acres. This cost is $4 less per acre than the annual cost of the sill/breakwaters from both shorelines alternative (FP8) as compared to the no-action plan. Aside from the small cost-per-acre advantage of FP2 over FP8, protection for the eastern shoreline is very important for Back Cove. Although the benefits to Back Cove were not quantified for this analysis, further erosion of the gut between the eastern shoreline of Fog Point Cove and the protective peninsula of Back Cove could eventually lead to degradation within Back Cove. Again, this was based on map study and anecdotal data from employees of the USFWS and no quantification of benefits was done. Therefore, based solely on the cost-effectiveness and incremental analysis data, FP2 is the best buy alternative for Fog Point Cove. See Appendix C for greater detail on these analyses.

4.4.5 Back Cove Alternatives Analysis

Back Cove is a large cove with vast expanses of SAV and shallow-water habitat. The cove is protected by two landmasses, one to the northwest and one to the southeast. A separate cost-effectiveness and incremental analysis was performed for the northwest shoreline alternatives and for the southeast shoreline alternatives because each landmass can be linked to specific environmental benefits. It is reasonable to conduct separate environmental and economic evaluations on each.

4.4.5.a Northwest Shoreline Habitat Protection. There were eight alternatives (BC1 through BC8) formulated for protection and restoration of the northwest shoreline of Back Cove, as discussed and shown in Section 4.3. BC2, 3, 4 and 5 are continuous nearshore sill structures, and BC6, 7, and 8 are nearshore segmented breakwater structures. Variables include whether or not the protection extends beyond the current landmass to provide more protection, and whether the plan includes backfill to create wetlands.

The northwest peninsula is entirely made up of highly erosive wetland habitat. The northwest peninsula shelters the Back Cove SAV beds from the open waters of the Chesapeake Bay; however, in recent years many breaches have formed in the peninsula that threaten the SAV habitat within the cove. Based on an expected continuation of the current rate of erosion of the wetlands in the future without a project, the projected wetlands loss over a 50-year period of analysis was estimated. The northwest shoreline of Back Cove is expected to lose 54.6 acres of wetlands over 50 years, or 1.1 acres per year. Each of the alternatives was assumed to eliminate the erosion of the emergent wetlands on the northwest shoreline of Back Cove. Further, they will all protect the existing SAV beds in the cove. The alternatives with an extension from the peninsula into the cove will provide an increased area of SAV habitat protection.

The alternatives without an extension from the northwest peninsula are expected to provide protection to approximately 2/3 of the existing SAV beds on the northwest shoreline of Back Cove. Since the total existing SAV in that area is 181 acres, the expected SAV protection benefits attributable to the alternatives without an extension from the peninsula is 121 acres.

The alternatives with an extension from the peninsula are expected to protect 100 percent of the existing SAV beds in the northwest section of Back Cove over the entire 50-year life of the Smith Island project. The expected benefits amount to 181 acres of protected SAV.

4.4.5.b Northwest Shoreline Habitat Creation. The alternatives will all create a more quiescent condition in the northwest portion of the cove, which will allow for restoration of historical SAV coverage. The average coverage of SAV habitat surveyed in the northwest portion of Back Cove on an annual basis from 1971-1998 was 306 acres. Only 181 acres of SAV remained during the 1998 survey. The potential restoration of SAV on the northwest shoreline is, therefore, 125 acres, the difference between the long-term average and the 1998 survey. As has been assumed for the other study sites, a 10-percent annual rate of restoration was used for formulation analyses. The alternatives without an extension were determined to create conditions conducive to restoration of approximately 2/3 of the annual average SAV habitat surveyed in the northwest portion of the cove from 1971-1998. The total potential restoration for these alternatives is, therefore, 83 acres. The restoration was assumed to occur at a rate of 8.3 additional acres per year until year 10, and then the coverage would remain constant at 83 acres. The discounted annual SAV restoration benefit is 62.4 acres. For the alternatives with an extension, the 125 acre difference between existing conditions and the long-term average was assumed to be restored at a rate of 12.5 acres per year until project year 10. The annual value of this restoration is 93.7 acres for alternatives with an extension from the northwest peninsula.

Alternatives have been formulated for both the sill and breakwater plans that would include created wetlands using fill material behind the structures. This analysis includes any stabilized (that is, planted) backfill as created wetlands. The estimated acreage of created wetlands is considered to be a benefit for the entire life of the plan.

4.4.5.c Cost-Effectiveness and Incremental Analyses. Table 4.12 presents the array of primary alternatives formulated for protection and restoration on the northwest shoreline of Back Cove that were rated as “moderate” or better for projected effectiveness in Table 4.5. As discussed previously, the breakwater projects without backfill were not considered further. The table includes preliminary estimates of alternative costs not including contractor mobilization and demobilization, real estate costs (as discussed in Section 4.4.3.c), contingencies or escalation due to future inflation.

The alternatives shaded in gray were screened out because there is at least one alternative that produces greater output for the same cost or the same output for less cost. The five alternatives considered were the nearshore sill alternatives (BC2, 3, 4, and 5) and the breakwaters with extension and created wetlands alternative (BC8). Outputs range from 189.3 acres to 281.3 acres, and the costs range from $2,343,000 to $3,236,000.

Table 4.12: Back Cove Northwest Shoreline Cost Effectiveness Screening (Outputs in Acres)

Alternative	Wetlands Protected	Wetlands Created	SAV Protected	SAV Restored	Total Output	Cost	Annual Cost
BC1 No Action	0	0	0	0	0	$0	$0
BC2 Sill	1.1	0	121	62.4	184.5	$2,557,000	$171,000
BC3 Sill with wetland creation	1.1	4.8	121	62.4	189.3	$2,861,000	$191,000
BC4 Sill with extension	1.1	0	181	93.7	275.8	$2,918,000	$195,000
BC5 Sill/extension with wetland creation	1.1	5.5	181	93.7	281.3	$3,236,000	$216,000
BC8 Breakwaters/ extension with wetland creation	1.1	5.5	181	93.7	281.3	$2,343,000	$156,000

4.4.5.d Back Cove Northwest Shoreline "Best Buy" Alternative. The results of the cost-effectiveness analysis clearly indicates that the breakwaters with an extension from the peninsula and created wetlands (BC8) alternative is the most productive alternative. In comparison to the other alternatives, the annual cost of the BC8 alternative is $15,000 less than any of the others. There is only one other alternative that produces the same amount of benefit (BC5), but it would cost $60,000 more on an annual basis. For these reasons, an incremental analysis was not conducted. See Appendix C for a more detailed analysis.

4.4.5.e Southeast Shoreline Habitat Protection. There were nine alternatives (BC9 through BC13a) formulated for protection of the southeast shoreline of Back Cove. The alternatives include continuous nearshore sill structures and segmented breakwater structures with and without extensions into the cove, and with and without backfill to create wetlands.

Based on an expected continuation of the current rate of erosion of the wetlands along the southeast shoreline in the future without a project, the projected wetlands loss over a 50-year period of analysis was estimated to be 24 acres, or 0.5 acre per year. Each of the alternatives was assumed to eliminate the erosion of the emergent wetlands on the southeast shoreline of Back Cove. In addition, the alternatives with an extension from the peninsula into the cove will protect the remaining 55 acres of SAV habitat in the cove. The alternatives without an extension are not expected to offer protection to the existing SAV.

4.4.5.f Southeast Shoreline Habitat Creation. The alternatives with an extension would provide conditions conducive to restoration of lost SAV habitat. The alternatives without an extension, however, will not likely create any SAV acreage. The average SAV coverage in the cove area protected by the southeastern shoreline from 1971 to 1998 was 157 acres. Only 55 acres of SAV remained during the 1998 survey. Therefore, the assumed potential restoration is 102 acres. The with-extension alternatives are expected to realize restoration of 10-percent per year for 10 years. The discounted annual value of the restored habitat over the project life is 76.7 acres.

Alternatives have been formulated for both the sill and breakwater plans that would include created wetlands using fill material behind the structures. This analysis includes any stabilized (that is, planted) backfill as created wetlands. The estimated acreage of created wetlands is considered to be a benefit for the entire life of the plan.

4.4.5.g Cost-Effectiveness and Incremental Analyses. Table 4.13 presents the six alternatives from Table 4.6, along with the no-action alternative, formulated for protection on the southeast shoreline of Back Cove that rated as "moderate" or better for projected effectiveness. The alternatives shaded in gray were screened out because there is at least one alternative that produces greater output for the same cost or the same output for less cost. The three alternatives remaining after the cost-effectiveness screening were the nearshore sill alternative (BC10), the breakwaters with created wetlands alternative (BC13), and the breakwaters with cove extension and created wetlands alternative (BC13a). The range of acreage benefits is from 0.5 acres to 138.9 acres and the cost ranges from $70,000 per year to $117,000 per year.

Table 4.13: Back Cove Southeast Shoreline Cost Effectiveness Screening (Outputs in Acres)

Alternative	Protected Wetlands	Wetlands Created	SAV Protected	SAV Restored	Total Output	Cost	Annual Cost
No Action	0	0	0	0	0	$0	$0
BC10 Sill	0.5	0	0	0	0.5	$1,045,000	$70,000
BC11 Sill + wetland creation	0.5	4.4	0	0	4.9	$1,415,000	$95,000
BC13 Breakwaters + wetland creation	0.5	4.4	0	0	4.9	$1,144,000	$76,000
BC10a Sill with extension	0.5	0	55	76.7	132.2	$3,306,000	$221,000
BC11a Sill with extension + wetland creation	0.5	6.7	55	76.7	138.9	$4,056,000	$271,000
BC13a Breakwaters with extension + wetland creation	0.5	6.7	55	76.7	138.9	$1,759,000	$117,000

Table 4.14 displays the results of the incremental analysis of the three remaining cost-effective Back Cove southeast shoreline restoration alternatives. The nearshore sill without extension alternative (BC10) was evaluated incrementally against the no-action alternative, the nearshore breakwaters with created wetlands alternative (BC13) was evaluated incrementally against BC10, and BC13a was compared to BC13.

The BC10 alternative produces an incremental output of 0.5 total acres of output in relation to the no-action alternative. The incremental annual cost per acre of output is $140,000. The BC13 alternative produces an incremental output of 4.4 total acres of output in relation to BC10 at an incremental annual cost per acre of output of $1,364. The BC13a alternative, the segmented breakwaters with an extension and created wetlands produced an incremental output of 134 acres over BC13 at an incremental cost of $306. Compared to the no-action plan, BC13a produces 138.9 acres at an incremental cost of $842 per acre. More detail on this analysis can be found in Appendix C.

Table 4.14: Incremental Values for Each Successive Cost Effective Back Cove Southeast Shoreline Alternative (Outputs in Acres)

Alternative	Total Output	Cost	Annual Cost	Incr. Cost	Incr. Output	Incr. $ per Acre Gained
No Action	0	$0	$0	0	0	0
BC10 Sill	0.5	$1,045,000	$70,000	$70,000	0.5	$140,000
BC13 Breakwaters and wetland creation	4.9	$1,415,000	$95,000	$25,000	4.4	$1,364
BC13a Breakwaters, extension and created wetlands	138.9	$1,759,000	$117,000	$22,000	134	$306

4.4.5.h Back Cove Southeast Shoreline "Best Buy" Alternative. The results of the cost-effectiveness and incremental analyses indicate that the breakwaters with an extension from the peninsula and created wetlands (BC13a) alternative is the most productive alternative. In comparison to the other alternative with an identical output of 138.9 acres, the annual cost of the breakwaters with an extension from the peninsula alternative is $154,000 less. In comparison to the nearshore breakwaters with created wetlands without extension alternative (BC13), the breakwaters with an extension from the peninsula alternative produces an increment of 134.4 annual acres of protected and restored habitat at an annual cost of $306 per acre of habitat output gained. Based on these cost-effectiveness and incremental analysis data, the breakwaters with an extension from the peninsula with created wetlands alternative is identified as the "best buy" for the southeast shoreline of Back Cove.

4.4.6 Terrapin Sand Cove Alternatives Analysis

4.4.6.a Habitat Protection. There are no remaining emergent wetlands on the Terrapin Sand Cove protective peninsula. The cove currently provides no protection for the 46 acres of remaining SAV habitat surveyed in 1998. Due to the location of the remaining SAV, the proposed alternatives will not offer protection from future losses. Therefore, the amount of habitat protected by the various alternatives was assumed to be zero.

4.4.6.b Habitat Creation. Creation of wetlands behind the proposed line of protection was considered to be infeasible due to the water depths in the cove. For SAV, the 1971-1998 annual average acreage in the cove was 479 acres. This number has been going down recently, including 1992 when coverages elsewhere were at recent maximums, due to the continued loss of the protective landmass. The situation at this cove provides an example of the conditions that can be expected in the future without a project in the other coves previously discussed. With re-establishment of protection along the alignment of the former peninsula, restoration of lost SAV is expected. The alternatives without an extension to the south are expected to provide conditions conducive to restoration of 120 acres of SAV habitat on an annual basis. The alternatives with an extension to the south will provide conditions conducive to restoration of 360 acres of lost SAV habitat on an annual basis.

4.4.6.c Cost-Effectiveness and Incremental Analysis. Table 4.15 presents the array of primary alternatives formulated for protection on the shoreline of Terrapin Sand Cove that rated as "moderate" or better for plan effectiveness in Table 4.7. The alternatives shaded in gray were screened out because there is at least one alternative that produces the same output for less cost. The two alternatives remaining after the cost-effectiveness screening were the breakwater alternatives, TS2 and TS5. These alternatives are expected to produce the same output in terms of acres of SAV restored as the screened out alternatives for a lower project cost. The breakwaters without an extension alternative (TS2) produces an annual output of 120 acres of SAV restored for an annual cost of $1,226,000. The breakwaters with an extension south alternative (TS5) produces 360 annual acres of SAV restored for an annual cost of $2,026,000.

Table 4.15: Terrapin Sand Cove Cost Effectiveness Screening (Outputs in Acres)

Alternative	Protected Wetlands	SAV Protected	SAV Restored	Total Output	Cost	Annual Cost
No Action	0	0	0	0	$0	$0
TS2 Breakwaters across cove	0	0	120	120	$18,356,000	$1,226,000
TS3 Sill across cove	0	0	120	120	$30,287,400	$2,023,000
TS4 Sill across cove with extension south	0	0	360	360	$42,267,000	$2,823,000
TS5 Breakwaters across cove + extension south	0	0	360	360	$30,336,000	$2,026,000

Table 4.16 displays the results of the incremental analysis of the two remaining cost-effective Terrapin Sand Cove restoration alternatives. The breakwaters without extension alternative (TS2) was evaluated incrementally against the no-action alternative, and the breakwaters with an extension south alternative (TS5) was evaluated incrementally against the breakwaters without extension alternative (TS2).

The breakwaters without extension alternative produces an incremental output of 120 total acres of output in relation to the no-action alternative. The incremental annual cost per acre of output is $10,217. The breakwaters with an extension south alternative produces an incremental output of 240 total acres of output in relation to the breakwaters without extension alternative. The incremental annual cost per acre of output is $3,333. The incremental cost of TS5 versus the no-action plan is $5,628 per acre annually.

Table 4.16: Incremental Values for Each Successive Cost Effective Back Cove Southeast Shoreline Alternative (Outputs in Acres)

Alternative	Total Output	Cost	Annual Cost	Incr. Cost	Incr. Output	Incr. $ per Acre Gained
No Action	0	$0	$0	N/A	N/A	N/A
TS2 Breakwaters across cove	120	$18,356,000	$1,274,000	$1,226,000	120	$10,217
TS5 Breakwaters across cove + ext.	360	$30,336,000	$2,095,000	$2,026,000	240	$3,333

4.4.6.d Terrapin Sand Cove "Best Buy" Alternative. The results of the cost-effectiveness and incremental analyses indicate that the breakwaters with an extension alternative (TS5) is the most productive alternative. In comparison to the other alternative with an identical output of 360 acres, the annual cost of the breakwaters with an extension from the peninsula alternative is $793,000 less. Moreover, the breakwaters with an extension alternative produces 360 annual acres of restored habitat at an incremental annual cost of $3,333 per acre of habitat output gained compared to an incremental annual cost of $10,217 per acre of habitat output gained for the breakwaters without an extension south alternative. Based on these cost-effectiveness and incremental analysis data, the breakwaters with an extension alternative and created wetlands is identified as the "best buy" for the shoreline of Terrapin Sand Cove. Due to the comparatively high cost of this alternative compared to the other "best buy" alternatives at the Western Shoreline, Fog Point Cove, and Back Cove, the study team decided not to recommend pursuing implementation of an alternative for Terrapin Sand Cove in this report. This is discussed further in the next section.

Section 5

SELECTED PROJECT

5.1 RECOMMENDED PLANS

Based on the plan formulation process described in the previous section, the study team developed a recommended project that includes components in each of the four project areas. The recommended project is composed of the following project areas: the Western Shoreline, Fog Point Cove, and the northeast and southwest Shoreline of Back Cove. The Terrapin Sand Cove plan identified in Section 4 is not recommended, due to high costs compared to the other project areas. The project discussed in this section was selected based on the cost-effectiveness and incremental analyses described in Section 4. The recommended alternatives from Section 4 were analyzed further and optimized by the project engineers. The concept-level designs and costs used to narrow the plan selection process have been finalized to feasibility-level and are presented here as the recommended project of this report. The recommended project is shown in Table 5.1. The plans are discussed in further detail below and in Appendix E. Note that the Fog Point Cove plan is different than that presented in Section 4. The rational for this change is discussed in Section 5.1.2. The benefits and estimated costs are summarized in Table 5.2.

Table 5.1: Recommended Plans

Project Area	Location	Structure	Length	Height	Backfill	Plants
Western Shoreline (SI18)	off-shore, from Swan Island to Fog Point Cove	Offshore breakwaters	9,420 ft.	+3.5 MLLW	15,000 CY/ 7.5 acres	*Spartina alternaflora*
Fog Point Cove (FP9)	off-shore, 600 ft. extension from western shore, 1,200 ft. from eastern shore	Offshore breakwaters and sill	1,950 ft.	+3.5 MLLW	6,600 CY/ 3.8 acres	*Spartina alternaflora*
Back Cove Northwestern Shoreline (BC8)	off-shore, along northwestern shoreline of Back Cove with extension into cove	Offshore breakwaters	5,950 ft	+3.5 MLLW	30,000 CY/ 10 acres	*Spartina alternaflora*
Back Cove Southeastern Shoreline (BC13a)	off-shore, along southeastern shoreline of Back Cove with extension into cove	Offshore breakwaters	1,950 ft.	+3.5 MLLW	10,000 CY/ 5 acres	*Spartina alternaflora*

5.1.1 Western Shoreline

The recommended plan for the Western Shoreline includes offshore breakwaters, located approximately 30 to 100 feet offshore, and stretching from Swan Island to the tip of Fog Point Cove. Although the plan was originally formulated to include structures placed 30 feet from land, the uneven coastline of the Western Shoreline makes it impractical to adhere strictly to such a tolerance. For ease of construction and cost purposes, the distance from shore is variable. The plan is expected to dramatically reduce erosion, stop the marsh from breaching, and reduce sedimentation, suspended solids and wave energy within Big Thorofare. The breakwaters provide natural shoreline, maintaining the access between the different habitat areas. The plan is expected to protect approximately 135 acres of marsh and 239 acres of SAV, and restore approximately 902 acres of SAV and 7.5 acres of marsh.

The final recommended plan includes a few alterations on the original concept plan of regularly spaced breakwaters as presented in Section 4. These changes are the result of rigorous technical analyses performed during the study, see Appendix E for more detail. The recommended plan does not contain the rigid regular spacing between the structures of the preliminary plan and incorporates longer structures in some areas. This design combines the benefits of both breakwaters and sills without significantly increasing the cost. The spacing of the breakwaters and the limited use of sills are designed to provide extra protection to the most threatened areas. Gaps will be placed in areas where there is room for the development of stable shorelines without danger of breaching. This layout reduces the risk of failure in the most important areas, but maintains the overall advantages of a breakwater system. The final construction layout will be developed during the PED phase based on the most recent survey data. The recommended plan is shown in Figures 5.1 through 5.4.

As discussed in Section 4, the Western Shoreline plan is recommended for its overall cost effectiveness and environmental benefits. Breakwaters, as opposed to sills, dramatically reduce the amount of stone needed for construction, thereby lowering construction costs. Although sills typically provide a more certain level of protection, in this case, a sill would have increased environmental impacts. By adding gaps in the protection, the plan will allow for the development of a natural shoreline, with the associated sandy shores and mudflats, blending the structures into the Smith Island ecosystem. The gaps will allow for natural accretion behind the structures and slight erosion behind the gaps, providing an extensive area of sand and mudflats, combined with protected coves. It is hoped that SAV will germinate within the gaps, adding SAV acreage to the island, though this potential growth was not quantified or applied as a project benefit.

Backfill for wetland creation is a component of the plan that was determined to be necessary to assure success. The created wetlands will also yield increased environmental benefits. The increased emergent marsh acreage is a clear benefit to the Smith Island ecosystem and supports the Chesapeake Bay Agreement wetland goals, making it an important element in meeting the project goals. As mentioned above, the wave and current action around breakwater structures will cause the backfill to assume a stable configuration that will allow for a natural transition of habitat types in the area. In addition, the backfill is expected to halt long-shore currents and sediment transport, provide additional effectiveness in preventing erosion, and decrease the risk of project failure. The backfill effectively links the structures to the existing marsh, developing a system that can stabilize the shoreline and allow sediment to accrete adjacent to the backfill. The existing erosional scarps are expected to be replaced by more gently sloping shorelines of mud or sand. The gentle slopes will allow for improved access between the resources of the shallow water and the emergent marsh. The more gradual shorelines are expected to benefit species such as shorebirds, terrapin, and anadromous fish.

5.1.2 Fog Point Cove

Through the formulation process it was determined that the sill from the western shoreline was necessary to protect the SAV by protecting the cove from the prevailing wave energy and currents. To restore the SAV within the cove, the eastern shoreline component is required, but this option was not favorable during the plan formulation process. The original recommended plan at Fog Point Cove (FP2) includes a stone sill, 600 ft. in length from the western shoreline. This plan would work to protect 29 acres of SAV. In order to realize 46 more acres of SAV restoration and protect approximately 7300 ft. of shoreline as terrapin breeding habitat a plan component for the eastern shoreline is required. Fog Point Cove, with its sandy shores, is thought to have the largest number of terrapin nesting sites per acre in Chesapeake Bay. Since these outputs are very desirable, and since the cost-effectiveness evaluation shows only a $9 difference per year per acre, the study team prefers implementation of FP8 over FP2. This option includes the 600 ft. sill on the western shoreline along with a 1,200 ft. stone breakwater system along the eastern shoreline. In addition, the eastern shoreline project is expected to help protect Back Cove. Although the benefits were not quantified, it is clear that Back Cove receives energy through the tidal gut separating Back Cove from Fog Point Cove. The component along the eastern shoreline will help stabilize this gut and prevent further erosion within the gut. This will prevent additional nutrients, sediments, and suspended solid particles from entering Back Cove and impacting the large SAV beds there.

Although not the least expensive option, backfill behind the sill structure (FP9) is recommended. Backfill, for wetland creation is cost effective when compared to other restoration projects throughout the bay and provides additional environmental benefits. Although not a critical design element, as on the Western Shoreline, it will increase the environmental benefits of the plan and will add marsh, terrapin nesting sites, and will tie the sill structure into the existing marsh ecosystem. Thus, although not critical, the backfill is considered an important part of the plan. Backfill is also recommended behind the breakwaters on the eastern shoreline to help assure success and to provide additional wetland, mudflat and sandy shoreline habitat. Pending difficulty in securing sufficient quantities of backfill or lack of acceptance during further sponsor and Corps review, this alternative may not be recommended instead of FP8 for public review. It is likely that the incremental cost of FP9 over FP8 will be reduced once the estimates are done for the recommended project, as opposed to the individual plans (that is, the cost of mobilization and de-mobilization, and dredging is spread across multiple plans within the Smith Island project).

The recommended plan, shown in Figures 5.5 and 5.6, also takes advantage of the additional certainty provided by a continuous sill where warranted on the western shore and the cost savings provided by the segmented breakwaters on the eastern shore. As on the Western Shoreline, the Fog Point Cove plan is formulated to provide extra protection in the most threatened areas. At Fog Point Cove, the most threatened area is the area near the western shoreline where a large peninsula that protected the cove historically has eroded away. It is along the western shoreline of Fog Point Cove that the wave energy is strongest and erosion is the most severe. The eastern shoreline is a lower energy area and segmented breakwaters are expected to provide adequate protection, at a lower cost. The breakwaters will reduce the wave energy and produce conditions for SAV restoration, while maintaining the sandy shoreline.

5.1.3 Back Cove

The recommended plan for Back Cove includes breakwaters and backfill on both the northwest and southeast shorelines. On the northwest side, the breakwater system will be approximately 5,950 ft. in length, including a 750-ft. extension into the cove. On the southeastern shoreline, the breakwater system will be approximately 2,950 ft including a 1,000-ft extension. The recommended plan is shown in Figures 5.7, 5.8 and 5.9. Note that Figure 5.9 does not show the recommended extension from the southeastern shoreline. This feature will be included in a drawing in the final report. As in the other areas, the gaps between the breakwater segments will be placed to provide maximum protection in the most threatened areas, especially along the northern peninsula, which has experienced several breaches in recent years. The northwestern extension will have few gaps, allowing extra protection from the wave energy within the cove. The recommended plan includes created wetlands as well. Backfill is considered to be extremely important behind the structures to tie the structures into the existing marsh and afford extra protection. Thus, the recommended plan combines the extra protection afforded by sills with the cost savings and environmental benefits of breakwaters.

5.1.4 Terrapin Sand Cove

Due to the high costs of the Terrapin Sand Cove component, no plan is recommended for implementation in that area at this time. Since this plan is a full order of magnitude more expensive than the other plans that are recommended, it can not be supported by the USACE or the sponsors. It is unlikely that a lower cost solution can be designed that would have tangible benefits. Anecdotal evidence suggests that the substrate has degraded since the erosion of the protecting marsh. Sand from the eroded peninsula has steadily migrated inland, burying SAV as the sediment moves. Had a plan been recommended, this situation would need to be studied more closely before construction. In comparison to the other plans on Smith Island, the Terrapin Sand Cove component can not be recommended.

5.1.5 Project Costs

The project costs by plan area are shown in Table 5.2, showing costs for the different project components: construction; lands, easements, rights-of-way, relocations and dredged material placement sites (LERRDs); pre-construction engineering and design; and monitoring. Construction includes the cost of stone, mobilization and de-mobilization, and labor. Due to the difficulty in construction on Smith Island, a 20% contingency was incorporated into the cost estimate. Because the project is being built in state waters, LERRD costs are expected to be negligible. The project will tie into Federal land, managed by the USFWS. The costs shown below have been refined from the planning level costs, and include a more accurate assessment of stone and backfill quantities, construction management, and other factors that were not incorporated into the preliminary planning costs. Many of the costs have decreased primarily because of the use of low volume breakwaters. This design allows for structures to be designed using significantly less stone, and is, therefore, more cost-effective than traditional designs. See Appendix E for a full M-CACES report and a discussion of the assumptions used for estimating purposes.

Table 5.2: Project Costs by Component (Baseline Costs – Nov 2000)*

Western Shoreline (SI18)	Cost	Contingency	Total
Construction	$2,018,000	$404,000	$ 2,422,000
LERRDS **	$1,000	$ 0	$1,000
PED	$268,000	$27,000	$295,000
Construction Management	$120,000	$24,000	$144,000
Total	**$2,407,000**	**$ 455,000**	**$ 2,862,000**
Fog Point Cove (FP9)			
Construction	$943,000	$189,000	$1,132,000
LERRDS	$ 0		$ 0
PED	$186,000	$19,000	$205,000
Construction Management	$57,000	$11,000	$68,000
Total	**$1,186,000**	**$ 219,000**	**$ 1,405,000**
Back Cove (BC8, 13a)			
Construction	$2,273,000	$455,000	$2,728,000
LERRDS	$ 0		$ -
PED	$213,000	$21,000	$234,000
Construction Management	$136,000	$27,000	$163,000
Total	**$2,622,000**	**$ 503,000**	**$ 3,125,000**
Monitoring	**$50,000**		**$50,000**
TOTAL PROJECT	**$6,265,000**	**$1,177,000**	**$7,442,000**

*** Some costs may not add up due to rounding errors**
**** LERRD estimate is $1,200 but is rounded to $1,000 for this table.**

5.2 BENEFITS AND IMPACTS OF THE RECOMMENDED PROJECT

The project is expected to restore and protect approximately 2,180 acres of habitat in the Smith Island ecosystem. Most of the benefits are expected to be through the restoration of SAV habitat on the interior of Smith Island, with over 1,400 acres of SAV expected to re-establish as a result of the project. An additional 504 acres of SAV and 215.7 acres of marsh are expected to be protected from future degradation. Construction of the proposed project will restore 23.5 acres of marsh to the island.

The large benefits to SAV are closely related to the protection of the surrounding marshes. The Smith Island ecosystem is a combination of upland hammocks, emergent marsh, and SAV, combined with mudflats and shallow water. The Smith Island project is designed to restore the ecosystem, by restoring the conditions that will allow natural re-colonization by plant and animal species. The project is designed to have beneficial impacts on the entire ecosystem, through stabilizing the marsh, protecting the SAV beds, and preventing nutrients and eroded sediment from entering the water column. In addition, improvements in the size and density of the SAV beds are expected to further reduce erosion, thereby providing additional protection to the marsh. Table 5.3 shows the outputs on an annual basis as discussed in Section 4.

TABLE 5.3: Expected Annual Project Outputs by Component (Outputs in Acres)

Alternative	Wetlands Protected	Wetlands Created	SAV Protected	SAV Restored	Expected Annual Output
Western Shoreline SI18: Breakwater + Wetland Creation	2.7	7.5	239	902	1151.2
Fog Point Cove FP9: Sill/Breakwater	0	3.8	29	34	66.8
Back Cove BC8 Breakwater and extension + Wetlands Creation	1.1	5.5	181	93.7	281.3
Back Cove BC13a Breakwater and extension + Wetlands Creation	0.5	6.7	55	76.7	138.9
Totals	**4.3**	**23.5**	**504**	**1106.4**	**1638.2**

The benefits of the project significantly outweigh the costs, and the per-acre cost of the Smith Island project makes it an exceptionally cost-effective restoration project. Table 5.4 shows the average annual cost for each of the project components. The annual cost of the project highlights the cost effectiveness of the project. The average annual cost per acre of benefit is only $300 per acre. Refinement of the cost estimates and project benefits during the detailed plan design phase of the study led to a cost reduction and additional benefits as compared to the planning numbers used in Section 4. The reason for this is because the final plans utilize a breakwater design referred to as "low volume" breakwaters. These structures are discussed in detail in Appendix E and allow less stone to be used during construction as compared to traditional designs. The anticipated benefits have increased somewhat, since the final design calls for structures that are further from the shoreline in some areas than the original concept designs thereby allowing for more marsh creation. The overall baseline cost including monitoring is expected to be $7,442,000 (November 2000), with a combined benefit of 2,180 acres. The many benefits associated with marshes and SAV beds make this project extremely beneficial to not only the Smith Island area but to the entire Bay ecosystem. The overall benefits and costs are shown in Table 5.5.

TABLE 5.4: Average Annual Cost of Each Selected Alternative - Baseline Costs (Output in Acres)

Alternative	Annual Output	Project Cost	Annual Cost	Average Cost per Acre
Fog Point Cove FP9	66.8	$1,405,000	$93,550	$1400
Back Cove BC13a	138.9	$915,000	$60,920	$439
Back Cove BC8	281.3	$2,210,000	$147,130	$523
Western Shoreline SI18	1151.2	$2,862,000	$190,580	$166

Table 5.5: Estimated Benefits and Costs of the Recommended Project, by Component (revised costs)

Project	BENEFITS					COSTS	
	SAV Protected (acres)	SAV Restored (acres)	Wetland Created (acres)	Wetland Protected (acres)	Shoreline Protected (miles)	Cost	Impacts
Western Shoreline (SI18)	239	1206	7.5	135.2	2.17	$2,862,000	15,000 cu yds of borrow
Fog Point Cove (FP9)	29	46	3.8	0	1.38	$1,405,000	13,000 cu yds of borrow
Back Cove (BC8,13a)	236	185	12.2	80.5	4.2	$3,125,000	40,000 cu. Yds of borrow
Monitoring						**$50,000**	
TOTAL	**504**	**1437**	**23.5**	**215.7**	**7.75**	**$7,442,000**	**68,000 cu. Yds.**

5.2.1 Risk and Uncertainty of Outputs

In any restoration project there are a number of factors that create risk. The largest source of risk for the proposed Smith Island project is the tremendous annual variability in the occurrence, coverage and density of natural SAV beds. SAV populations in areas around Smith Island have been known to vary over 50-percent from year to year, making future predictions difficult. For this reason, SAV benefits from the project may be more or less than expected. In reality, the benefits are expected to vary up to 20-percent either way from expected outputs. The 20-percent figure was determined based on conversations with SAV experts and the professional opinions of the study team. Despite the risk, the project maintains exceptional benefits to the Bay Ecosystem. Table 5.6 shows the risk for SAV restoration at each study area. Risk is lowest in terms of wetland protection and creation. Backfill minimizes risk to the protected wetlands, by connecting the structures to the existing marsh. Monitoring of the created wetlands can help further reduce the risk since early risk factors or problems in design or implementation can be corrected after construction.

TABLE 5.6: Range of Potential Annual Outputs by Study Area (+/– 20% deviation from expected value for SAV Restored) (Outputs in Acres)

Alternative	Wetlands Protected	Wetlands Created	SAV Protected	SAV Restored Range	Expected Annual Output Range
Western Shoreline SI18	2.7	7.5	239	722-1,082	971-1,331
Fog Point Cove FP9	0	3.8	29	27-41	60-74
Back Cove BC8	1.1	5.5	181	75-113	263-301
Back Cove BC13a	.5	6.7	55	61-92	123-154
Totals	**4.3**	**23.5**	**504**	**885-1328**	**1,417-1,860**

The project benefits can be thought to have varying risk, with more risk associated with the features that require natural regeneration. In the short term, created wetlands have the least risk, as these benefits are completely controlled through engineering and design. Careful monitoring dramatically reduces the long-term risk associated with created wetlands, by providing a mechanism to monitor and assess the wetland growth over time, including necessary maintenance. The protected wetlands also have very low risk associated, as breakwaters are known to be effective at reducing or eliminating erosion. Nonetheless, it is unclear how many years are necessary for an equilibrium to be reached, where erosion and sedimentation are equivalent. Some risk is associated with the gaps within the structures, allowing for continued erosion at certain locations. A further discussion of the risks associated with the uncertainty of project outputs is presented in Appendix C.

5.2.2 Uncertainty of Project Costs

Table 5.7 presents a range of values for project costs. The first two columns display the project cost and the annual cost of the recommended projects. The middle columns display the project cost and the annual cost assuming that the cost will be 20 percent greater than the estimated cost. The two columns on the right show the project cost and the annual cost assuming the actual cost is 20 percent less than the estimated level.

TABLE 5.7: Range of Project Costs by Study Area (+/- 20% deviation from estimated project costs)

Alternative	Project Cost	Annual Cost	Project Cost + 20%	Annual Cost +20%	Project Cost - 20%	Annual Cost -20%
Fog Point Cove FP9	$1,405,000	$93,550	$1,686,000	$112,260	$1,124,000	$74,840
Back Cove BC13a	$915,000	$60,920	$1,098,000	$73,100	$732,000	$48,740
Back Cove BC8	$2,210,000	$147,130	$2,652,000	$176,560	$1,768,000	$117,700
Western Shoreline SI18	$2,862,000	$190,580	$3,435,000	$228,700	$2,290,000	$152,460

Table 5.8 presents a sensitivity analysis to determine the change in average cost per acre of habitat output if the restored SAV habitat is 20-percent less than expected and the project cost is 20-percent greater than currently estimated. This scenario represents the worst outcome given the parameters of the sensitivity analysis. The average cost per acre of habitat output with this scenario is $417, which is $117 per acre more than the cost per acre resulting from the costs and outputs used in the Tables above.

TABLE 5.8: Average Cost Analysis
(Assumes 20% cost increase and 20% SAV Restored decrease)

Alternative	Total Output	Project Cost	Annual Cost	Average Cost
Fog Point Cove FP9	60	$1,686,000	$112,260	$1871
Back Cove BC13a	123	$1,098,000	$73,100	$594
Back Cove BC8	263	$2,652,000	$176,560	$671
Western Shoreline SI18	971	$3,435,000	$228,700	$236
Totals	**1,417**	**$8,871,000**	**$590,6200**	**$417**

5.2.3 Summary of Cost-Effectiveness and Incremental Analyses

A cost-effectiveness and incremental analysis process was used to evaluate the alternatives formulated for the protection and restoration of habitat on Smith Island. Separate evaluations were conducted for each of the project sites. The evaluation identified five alternatives as "best buy" alternatives for their respective project sites. One of the recommended plans, Terrapin Sand Cove, subsequently was dropped due to high costs. The expected annual habitat value of the remaining four alternatives is 1,638 acres. The estimated baseline cost of implementation of the four plans is $7,442,000. The annual cost over the 50-year project life is $492,000. The average cost per acre of habitat with construction of the four project components is $300.

A sensitivity analysis was performed to measure the effect on the average cost per acre of habitat of variations is project costs and project outputs. The analysis used a cost estimate 20-percent greater than the current estimate and an output level 14-percent less overall than the expected output level. Note that the total output level is 14-percent less and not 20 since only restored SAV was considered to be variable. These variations resulted in a cost of $8,871,000 and habitat output of 1,417 acres annually. The resulting cost per acre of habitat with construction of the four recommended alternatives is $417, an increase of $117 per acre from the expected levels.

5.3 STAGED CONSTRUCTION AND MONITORING

The project will require staged construction, since all the components could not be completed within one construction season, and monitoring is required. As an environmental project that emphasizes natural processes, monitoring is necessary to assess project success and, if necessary, to implement project changes and modifications.

Monitoring has been divided into two phases: pre-construction and post-construction. The pre-construction monitoring is expected to last one year, will be implemented during the PED phase and is expected to cost approximately $7000. The goal of the pre-construction monitoring is two-fold. First, it is to assess the existing conditions, so that the pre- and post-project conditions can be evaluated. The one-year pre-construction data will be evaluated against the post-construction monitoring. The second goal is to help collect the latest data for the detailed design work. Data collected during the pre-construction monitoring will include: SAV extents and density, current erosion rates, the location of existing breaches, mudflats, and sand beaches, and counts of waterbirds and terrapin nesting locations.

The post-construction monitoring will last five years and cost approximately $40,000. Monitoring data will be used to evaluate project success and to establish the need for adaptive management. Post construction monitoring will consist of the following:

- Erosion assessment: has marsh erosion been prevented. Survey data will assess the rate of shoreline change over time. Surveys will be taken in the year before construction (year 0), the first year after construction (year 1), and the final year of monitoring (year 5) at each site. This will evaluate the project's effectiveness in reducing erosion in the different areas.

- Vegetation monitoring: Field surveys will be used to examine the success of the planted vegetation. Field surveys will be conducted each year during the growing season to estimate percent cover of the project area and monitor the colonization of the created wetlands. Vegetation trends will be analyzed and reported to the project team.

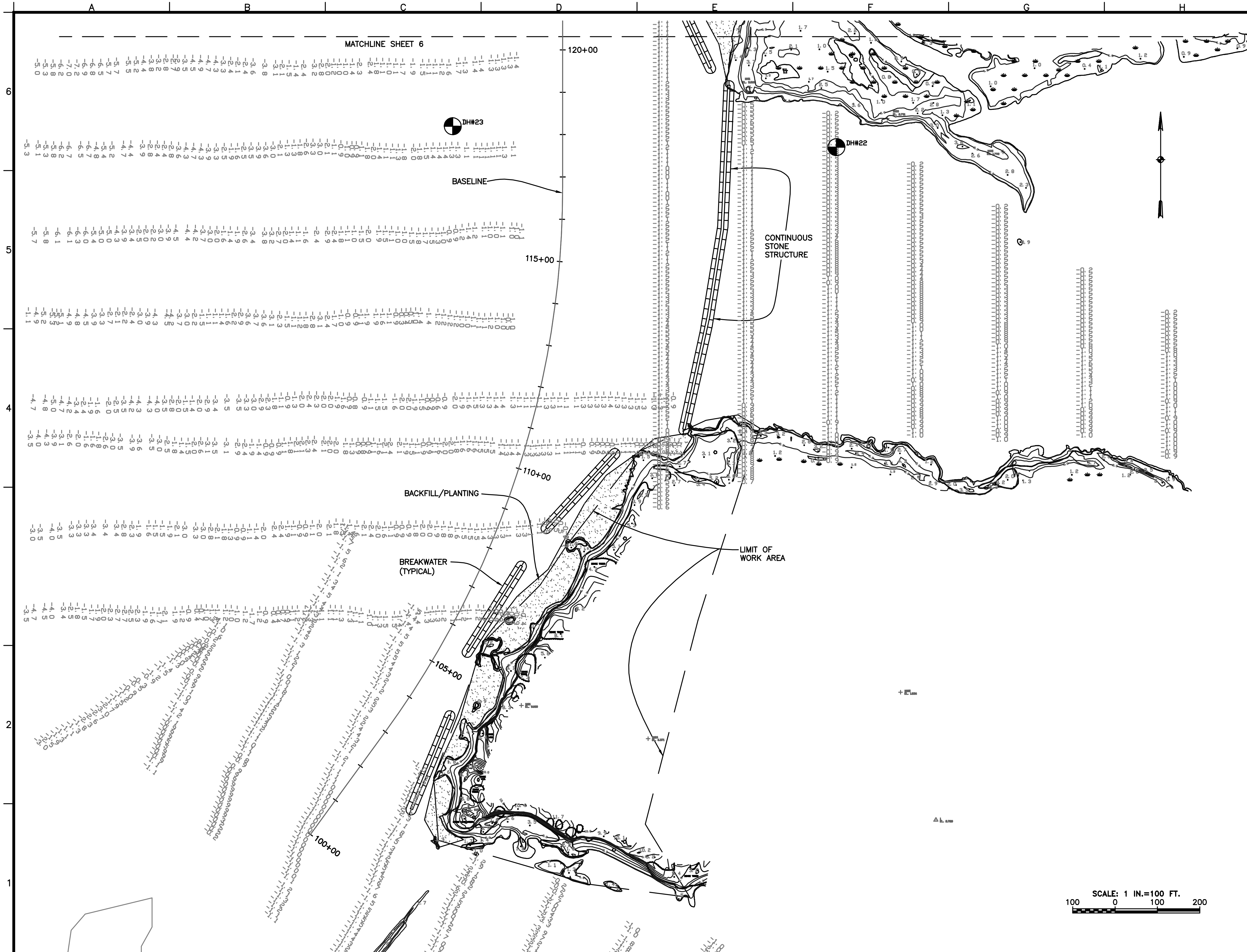
- SAV density and extent: SAV monitoring will consist of using the aerial photography collected by the Virginia Institute of Marine Science (VIMS), which conducts annual surveys of all bay grasses. Bay grasses surrounding Smith Island will be monitored for changes in coverage, density and species. In addition, ground-truthing will be conducted within the coves and behind the breakwaters, to assess the accuracy of the VIMS data and assess project success. SAV will be monitored in each of the coves and within Big Thorofare.

- Wildlife usage: Smith Island provides an important opportunity to assess the wildlife usage of created wetlands. The monitoring will focus on usage by waterbirds and on diamondback terrapins, assessing pre-and post-project usage by these organisms. Counts of terrapin nesting sites and waterbird usage will be conducted annually.

The purpose of the monitoring plan is to evaluate the success of the project and identify management techniques to maintain the integrity of the Smith Island ecosystem. The monitoring is expected to be conducted in partnership with the USFWS.

5.4 REAL ESTATE CONSIDERATIONS

The majority of the project is being constructed below the mean high water line. A staging area will be required on Swan Island, on property owned by the Federal government and managed by USFWS. See Appendix D for detailed real estate information.



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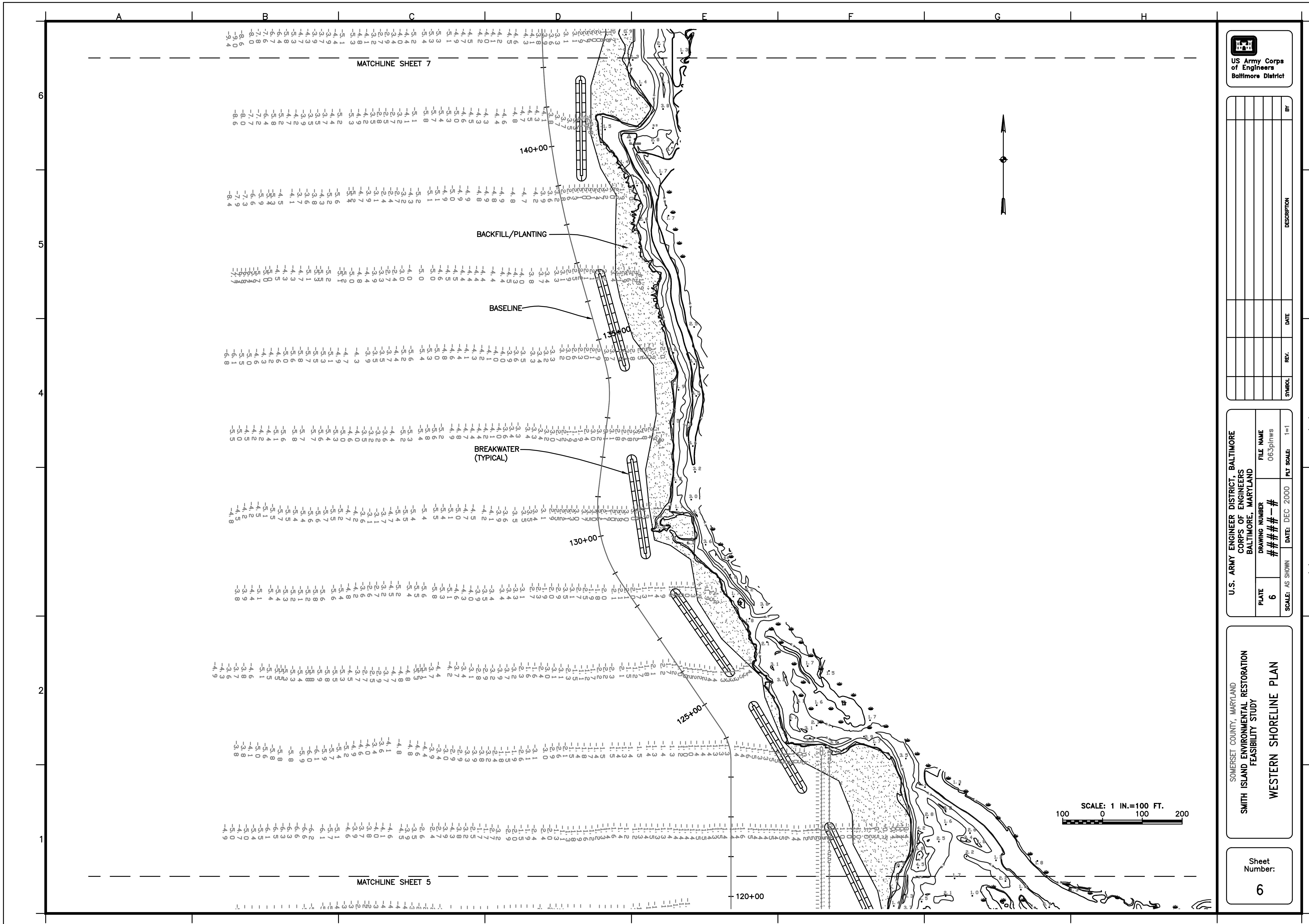
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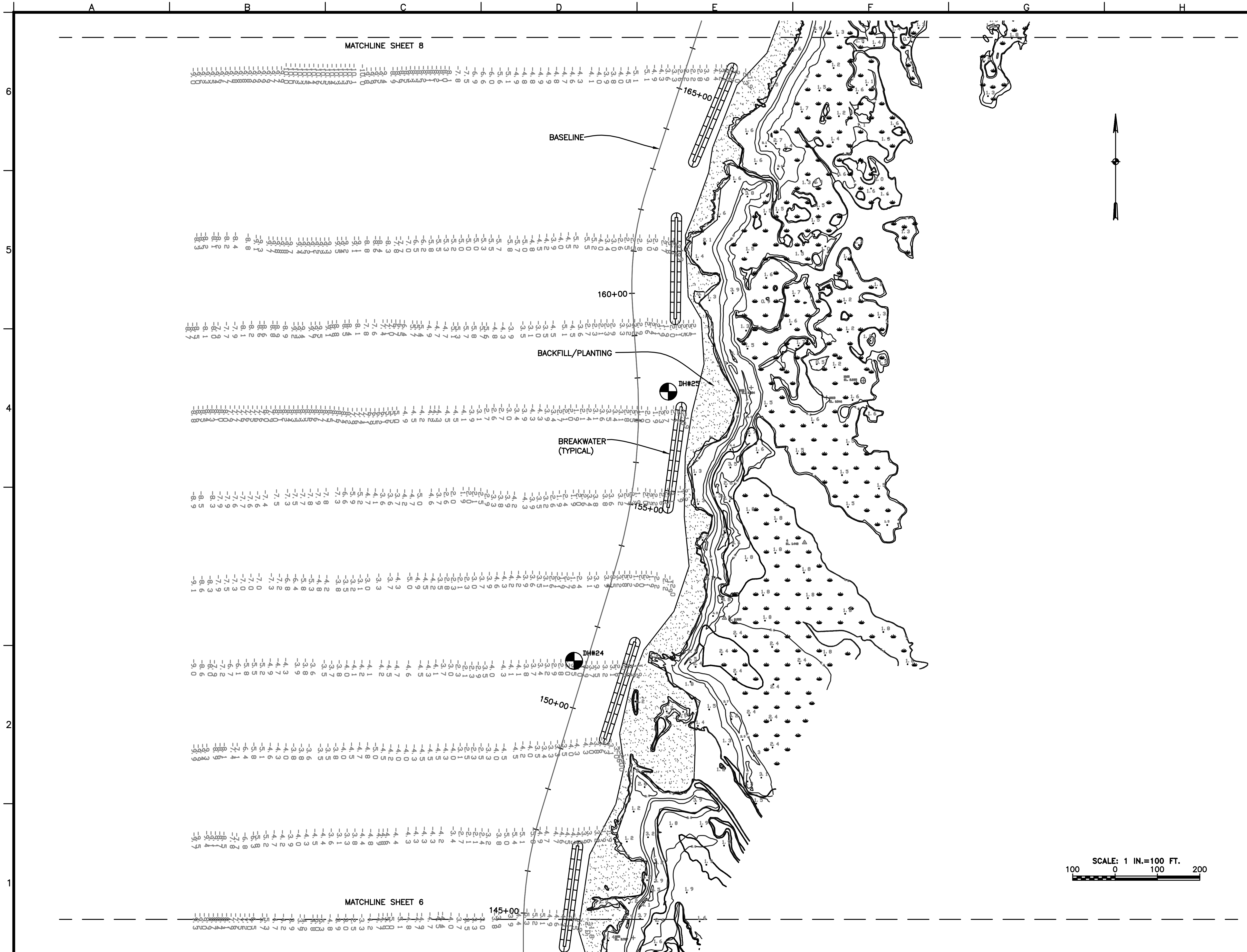

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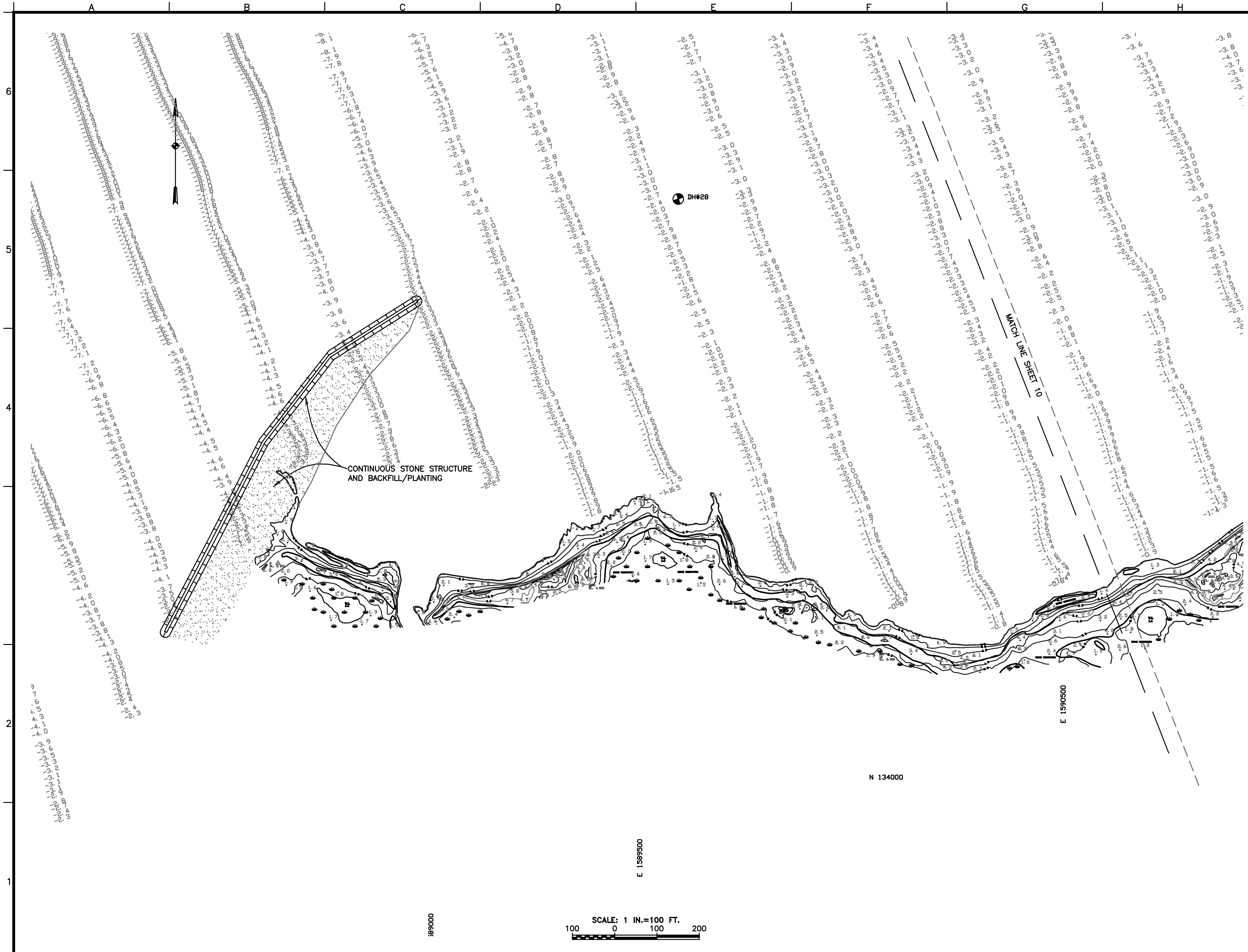

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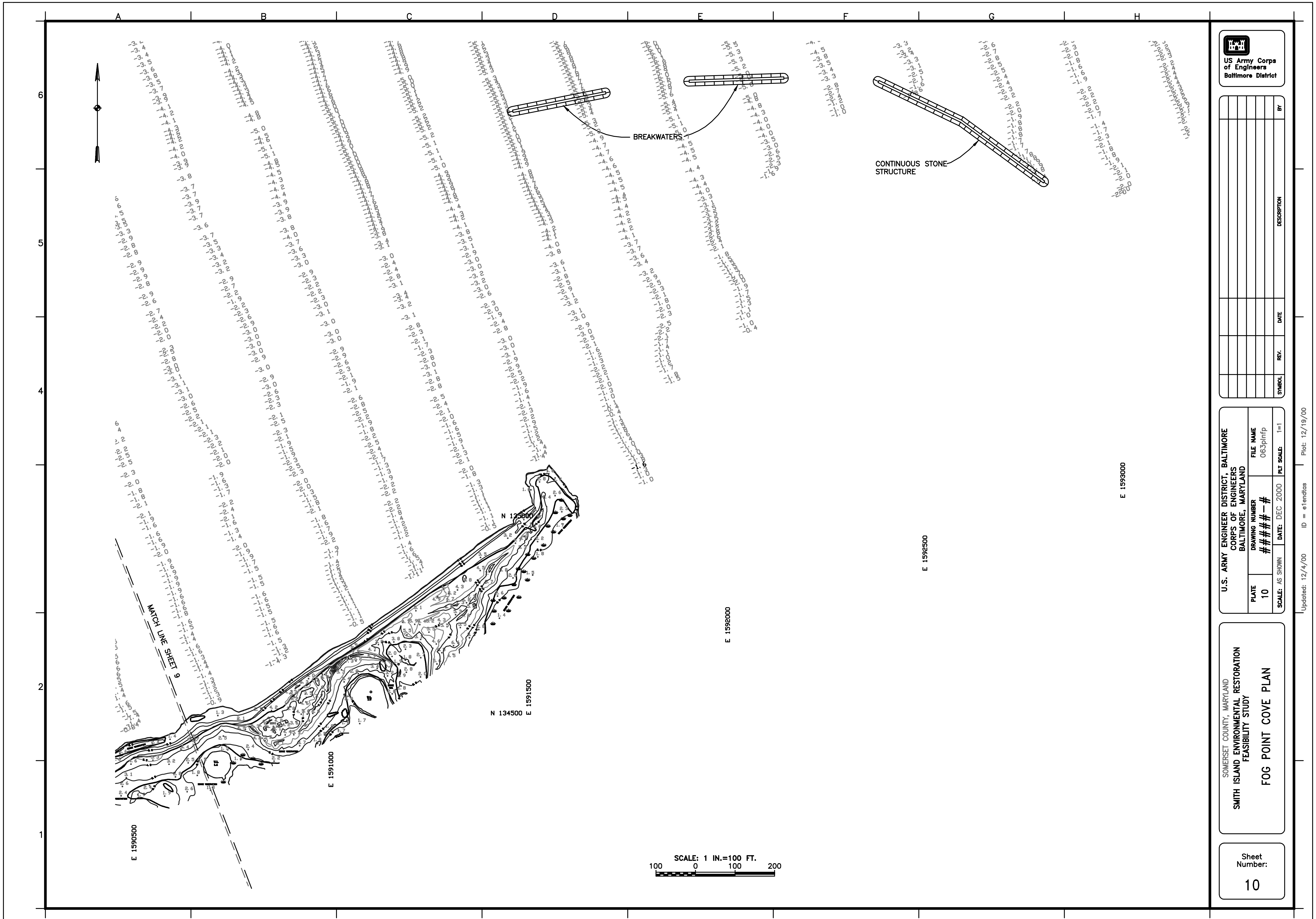

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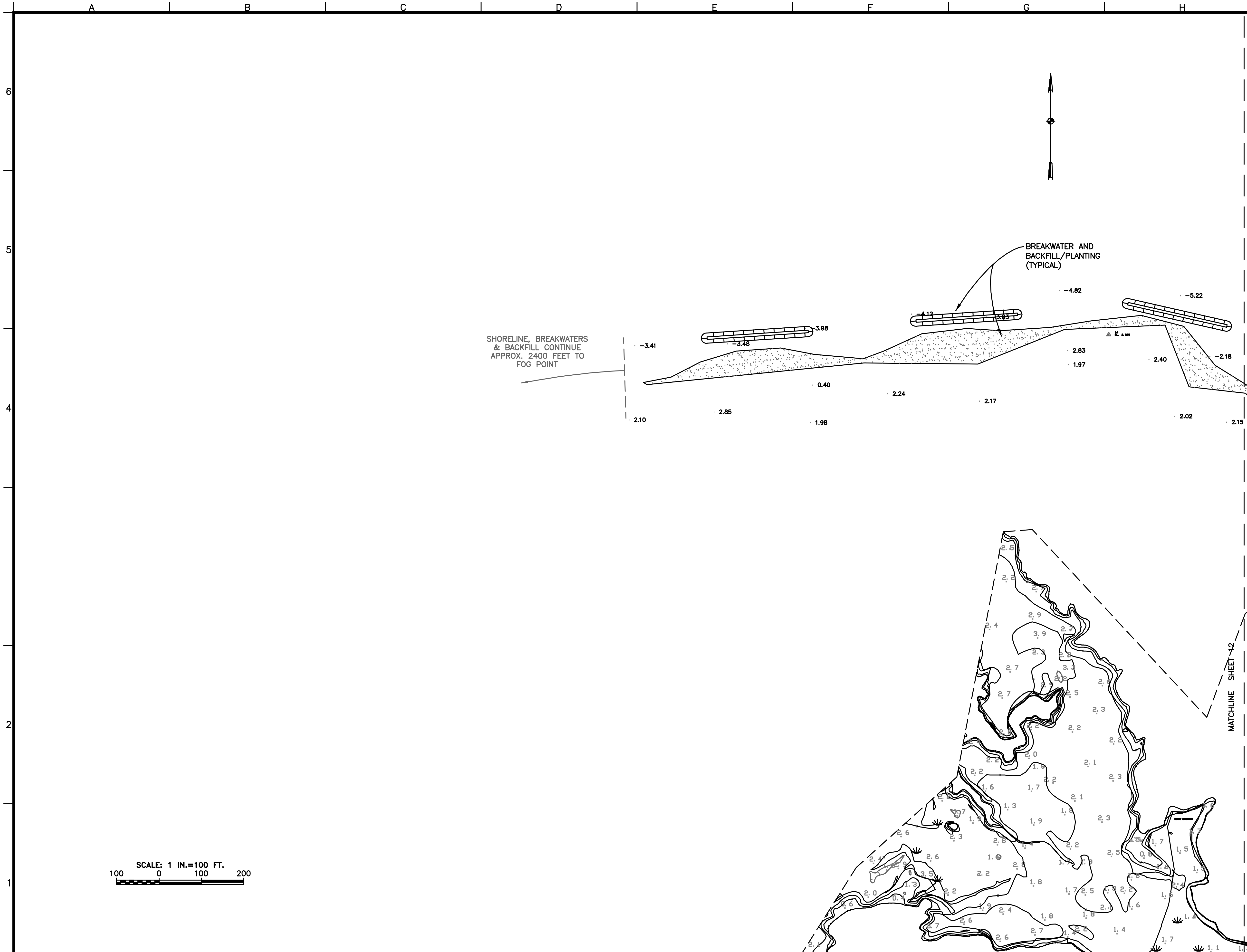

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BACK COVE PLAN
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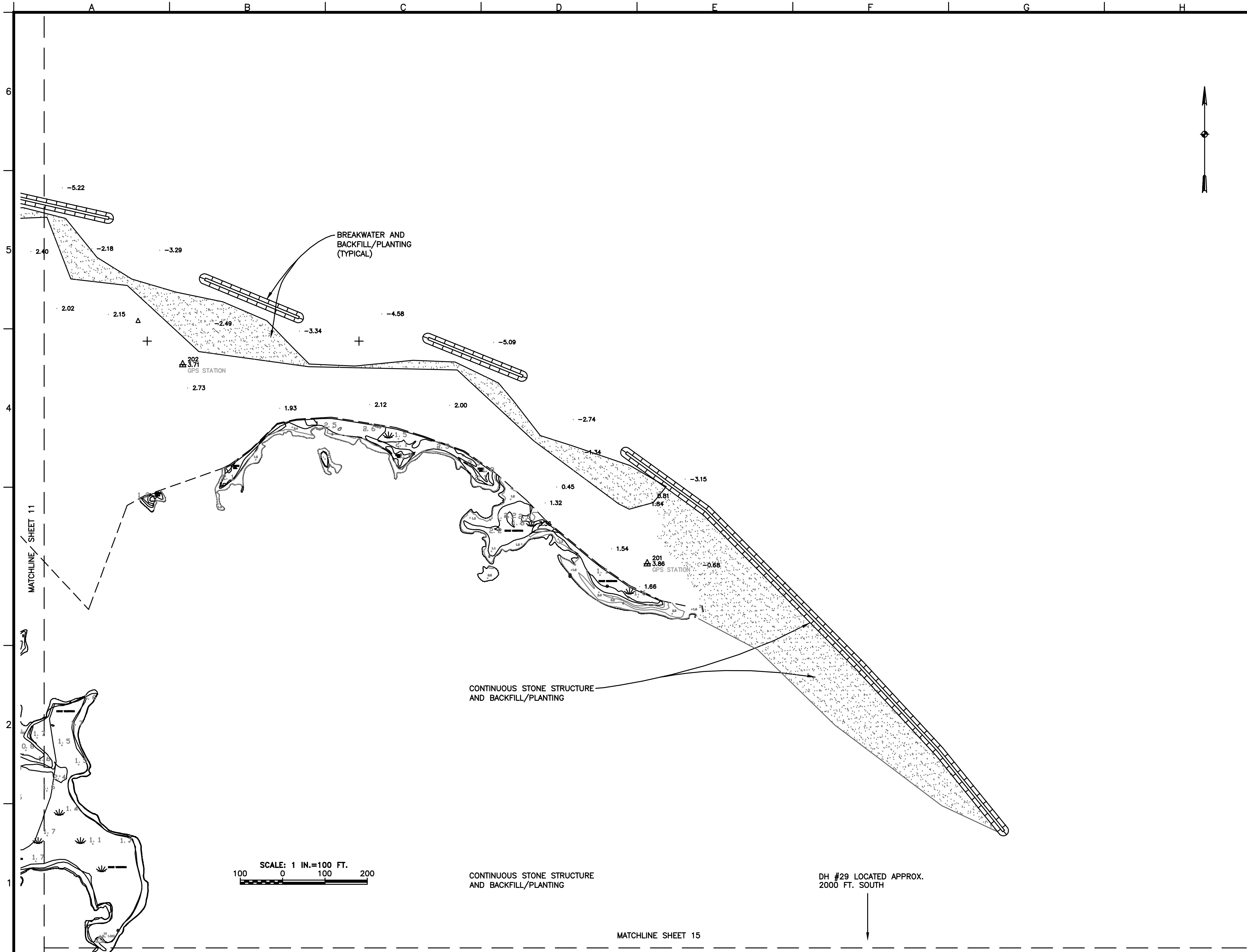

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Baltimore District

SYMBOL	REV.	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

PLATE	DRAWING NUMBER	FILE NAME
12	####-#	063plnbc
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SOMERSET COUNTY, MARYLAND
SMITH ISLAND ENVIRONMENTAL RESTORATION
FEASIBILITY STUDY

BACK COVE PLAN
NORTH PENINSULA & SHORELINE

Sheet Number:
12

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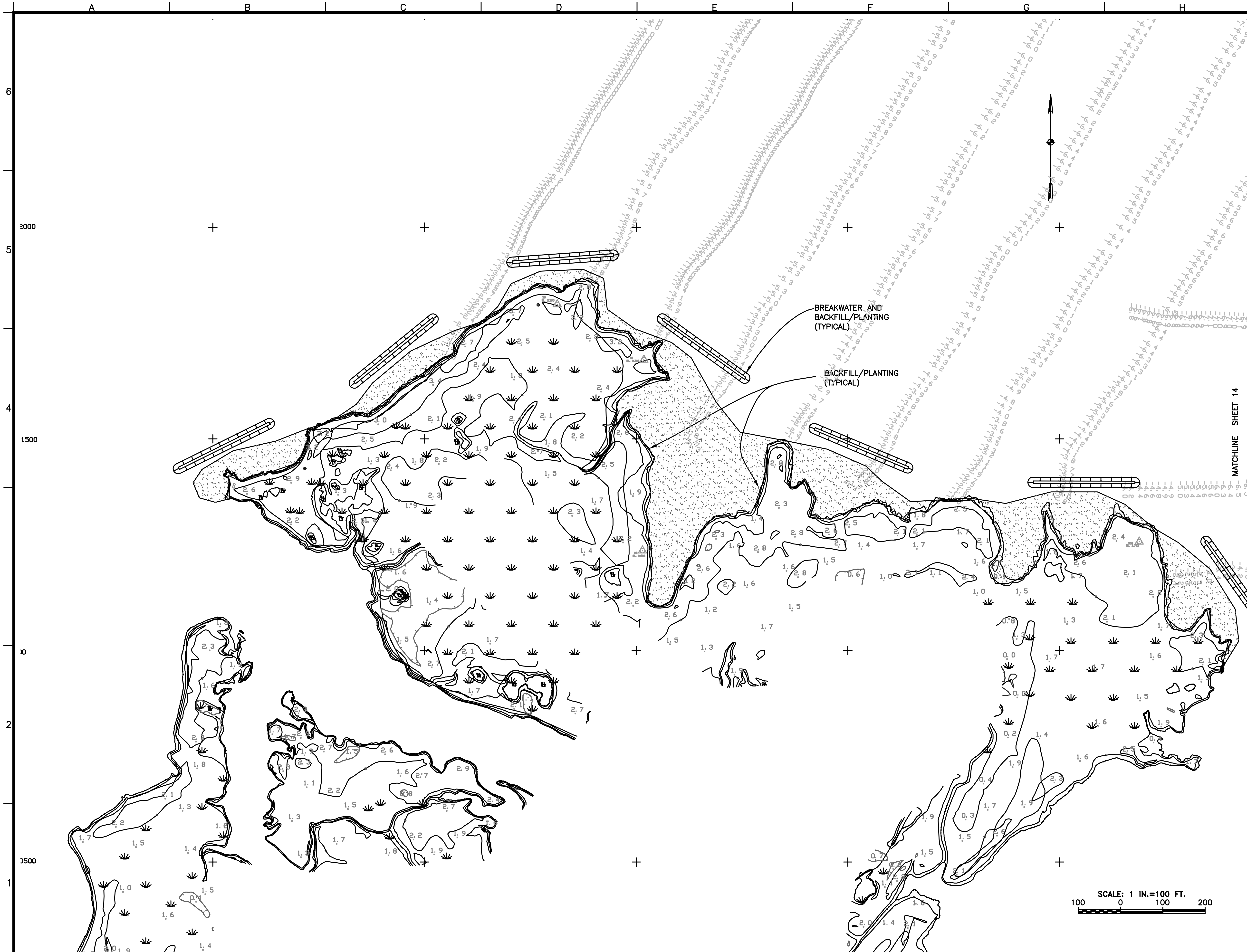

US Army Corps of Engineers
Baltimore District

SYMBOL	REV.	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

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SCALE: AS SHOWN	DATE: DEC 2000	PLT SCALE: 1=1

SOMERSET COUNTY, MARYLAND
SMITH ISLAND ENVIRONMENTAL RESTORATION
FEASIBILITY STUDY

BACK COVE PLAN
SOUTHEAST SHORELINE

Sheet Number: 13

10/12/00 e1endtas 10/12/00

Section 6

PROJECT IMPACTS TO THE ECOSYSTEM

6.1 PHYSICAL SETTING

Since the Tylerton erosion control plan and the Rhodes Point navigation plan were removed from the study, the remaining plans involve only areas within the waters of the State of Maryland that surround the Martin National Wildlife Refuge. Though benefits will be felt throughout the Bay and within the human population of Smith Island, none of the projects will directly affect any of the populated areas. The plans have been designed to be compatible with the existing condition and sensitive to the needs and desires of the local residents. The recommended project will provide incidental benefits that help to protect and restore the Wildlife Refuge and, at the same time, may provide some improvement to the town of Ewell in terms of erosion protection and navigation.

6.2 ECOLOGICAL PROFILE

This section addresses the project impacts to the Smith Island ecosystem, including cumulative impacts from combined Federal and non-Federal activities into the foreseeable future. Potential impacts were assessed with regard to the physical, chemical, and biological characteristics of the aquatic and terrestrial ecosystem, endangered and threatened species, hazardous and toxic materials, aesthetics and recreation, cultural resources, and the general needs and welfare of the public. The proposed project is expected to have minor, temporary environmental impacts, combined with long-term beneficial impacts to a variety of ecosystem habitats and functions. The project is expected to have minor, temporary impacts to approximately one acre of wetlands and several acres of shallow water. These impacts are unavoidable and minimal, as disturbed organisms can relocated to a variety of other suitable locations nearby. The area is predominately shallow water, SAV, and marsh, and the project will exchange short-term impacts for long-term benefits and protection of the overall ecosystem.

For the ecological evaluation, the project is considered in its entirety, with components along the Western Shoreline, Fog Point Cove, Back Cove, and Terrapin Sand Cove. At the end of the chapter, the cumulative impacts of each project component area are discussed. A 404 (b) (1) evaluation, regulating fill activities within waters of the United States, is included in Appendix A.

6.2.1 Wetlands

6.2.1.a Emergent Marsh. The offshore breakwaters were selected as the most environmentally appropriate alternative to the problems of Smith Island. The breakwater system within the project areas effectively avoid impacts to the existing marsh. The project is expected to have minor, temporary impacts to the emergent marsh on Smith

Island and have extensive positive impacts. The project footprint is entirely within the shallow waters, approximately 30 to 100 feet off the present shoreline, resulting in no negative impacts to the marsh. Approximately 68,000 cubic yards of clean sand will be used to create 23.5 acres of marsh behind the structures. The gaps within the breakwaters will allow for the development of a natural shoreline and maintain the existing marsh hydrology. Wildlife species will continue to migrate between the marsh and the mudflats, which may form behind the breakwater systems. The existing marsh vegetation is expected to colonize the created marsh areas and blend into the existing island landscape.

Construction of the breakwater system is expected to require the use of approximately one acre of marsh, located on Swan Island, for use as a staging area. The staging area is an unavoidable component of the project. Nearly the entire land area of Martin Wildlife Refuge is wetland, necessitating minor impacts for long term protection. This area is currently disturbed, having been used as a former dredged material placement site. After construction, the site will be returned to its natural condition and impacts are expected to be minor and temporary. Best management practices will be used to the extent practicable and USACE will minimize and avoid impacts to the extent practicable. By using Swan Island, an already impacted area, USACE minimized impacts to the wetlands near the structures and allows for streamlined access to the construction sites.

The project is expected to protect vast areas of the marsh from future erosion, protecting approximately 216 acres of marsh over the next 50 years, if erosion continues at its historical rate. The project is expected to dramatically reduce erosion, providing the marsh the opportunity to accrete, helping to offset sea-level rise. An additional 23.5 acres of marsh will be created and creating more habitat for the variety of species that inhabit Smith Island marsh. By reducing erosion, it is expected that the quality of the marsh edge will improve, allowing for more terrapin nesting sites and preventing the steep erosional features observed today.

6.2.1.b Submerged Aquatic Vegetation. The proposed project is expected to have no negative impacts to existing SAV and is designed to have a large positive impact in Big Thorofare and the northern coves. The breakwaters are designed to avoid areas of consistent SAV growth. Although the structures are being placed in shallow water where there is no sustainable SAV, the footprint of the structures are relatively small, approximately 15 by 150 ft depending on the height of the structure. The cumulative impact to shallow water is approximately 130,000 sq-ft. (2.98 acres). The structures will permanently prevent the growth of SAV within the footprint; however, they are designed to encourage SAV growth within the coves, off-setting the loss.

The structures may have a positive impact on SAV in a number of ways. First, the structures will repair and prevent marsh breaching, preventing the eroded sediment from choking the SAV in Big Thorofare and the coves. Second, the structures will reduce the wave energy and the rate of marsh loss, effectively reducing the amount of total suspended solids (TSS) and nutrients entering the Smith Island system. By reducing the TSS and nutrients, it is anticipated that more light will reach the Bay bottom, encouraging SAV germination. Third, the breakwaters will reduce the wave energy within the coves, creating more quiescent water with less material resuspension, necessary for SAV growth. The project is expected to help restore hundreds of acres of SAV, allowing the existing beds to expand and regenerate to their historic extent.

Although SAV distribution is a product of both regional and local factors, anecdotal evidence from Eastern Neck National Wildlife Refuge, Tedious Creek, Terrapin Beach, and other areas shows new SAV germination behind the breakwaters. It is anticipated that SAV can colonize these areas, adding to the overall SAV beds within the system. The project will have large beneficial impacts because SAV is expected to colonize into its historic areas and may develop in new areas.

6.2.2 Benthics

The benthic community is expected to relocate from the construction area, and 130,000 sq. ft. (2.98 acres) of soft-bottom habitat will be permanently altered from construction, dislocating any resident benthic populations. An additional 23.5 acres of benthic habitat will be converted into tidal marsh. The project is designed to avoid impacts to existing SAV and known oyster bars. Despite the loss of habitat, the project is expected to have beneficial impacts to the interior SAV beds, developing higher quality benthic habitat in the remaining areas. In addition, the stone breakwaters are expected to provide hard surfaces for a variety of sessile organisms, such as barnacles, clamworms, and snails. At present, the substrate is soft and hard surfaces are rare offshore of Smith Island.

During construction, 68,000 cubic yards of material will be excavated from the Bay floor, temporarily impacting benthic communities. Borrow sites will avoid all known areas of prime shallow water habitat, including SAV beds and oyster bars. Time of year restrictions and all best management practices, developed in consultation with the environmental review agencies, will be used to further minimize the impact from dredging. The borrow sites will not be excavated more than three feet below the existing bottom and benthic communities are expected to re-establish soon after the excavation. Thus, adverse impacts are expected to be minor and temporary. Shoaling is expected to refill the borrow sites within several years after project construction, returning the borrow area to its natural conditions.

Because of the benefits to SAV beds and the reduction of marsh erosion, overall impacts to the benthic community are expected to be positive.

6.2.3 Aquatic Resources

6.2.3.a <u>Phytoplankton and Zooplankton</u>. The project is expected to have only minor, temporary adverse impacts to phytoplankton and zooplankton. Construction may temporarily add turbidity and impact habitat areas. Conditions are expected to return to normal several months after construction. Equilibrium condition is expected to establish soon after construction finishes. All appropriate best management practices will be used

6.2.3.b Fish. A short-term increase in turbidity during construction and resulting disturbance will cause some fish species to temporarily relocate. Best management practices will be used to control turbidity and minimize adverse impacts to resident fish during construction. Approximately 2.97 acres of shallow water will be lost due to the construction of the breakwaters, and approximately 23.5 acres will be converted into emergent marsh. Approximately 68,000 cubic yards of fill borrow material may be taken from the Bay, increasing the water depth in some areas of the borrow area. The dredging footprint will be selected based on avoiding sensitive areas and minimizing impacts, through coordination with NMFS. However, shallow water habitat is plentiful in the area, providing numerous areas for fish species to relocate. The project preserves the natural shoreline and maintains access into the marsh through the numerous tidal guts, preserving anadromous fish access.

Because shallow water is common in the area, adverse impacts from the project are expected to be temporary and minimal to the nekton populations. The EFH species are able to locate to nearby habitats and are expected to recolonize after construction. Bluefish are rare in the area during winter months. Therefore, the bluefish is unlikely to be affected by the proposed actions. The Baltimore District, after reviewing fisheries information, has determined that the proposed action is not likely to significantly or adversely effect EFH or species covered under the Magnuson-Stevenson Act. No mitigation is proposed because negative impacts are not clearly demonstrated.

The use of stone breakwaters will provide hard surface habitat for a variety of creatures, providing food and hiding spaces for a number of fish species. Thus, adverse impacts are expected to be minimal and temporary while beneficial impacts are expected to be long term and sustainable.

6.2.3.c Commercially Important Species. The commercially important species within the project footprint are blue crab, rockfish, diamondback terrapin, menhaden, and a variety of other fish species. The project is not expected to have any long-term negative impacts to these species. The commercially important species are expected to temporarily relocate during construction, although re-colonization is expected a few months after construction finishes. Thus, adverse impacts are expected to be minor and temporary and beneficial impacts to be long-term and sustainable.

The project is designed to protect and restore SAV habitat, which provides exceptional blue crab habitat. Thus, the project is expected to provide large beneficial impacts to the blue crab. Because the project will reduce erosion along the coastlines, creating more sandy shorelines, impacts to the terrapin are also expected to be long-term and positive. No long-term impacts to the fish species are expected.

6.2.4 Terrestrial Resources

6.2.4.a Mammals. Terrestrial and aquatic mammals may avoid the staging area during construction. However, most construction is in the water and habitat quality in the staging area is low. Avoidance of the area will cause no significant long-term, adverse impacts to mammals. The use of the staging area on Swan Island is unavoidable, although impacts from the staging area to mammals are expected to be short-term and minimal.

By slowing wave energy, thus slowing shoreline erosion, the project will provide habitat protection for terrestrial mammals, such as muskrat. Long-range impacts, by protecting wetland habitats, are expected to be beneficial to mammal species.

6.2.4.b Reptiles and Amphibians. Aquatic reptiles (turtles and snakes) and amphibians may temporarily relocate out of the project area. Most of the construction will be conducted in open water, providing opportunity for resident reptiles and amphibians to relocate. As only a small area of marsh is being utilized as a staging area, few negative impacts are expected. The use of the staging area on Swan Island is unavoidable, and impacts from the staging area to mammals are expected to be short-term and minimal. Organisms are expected to re-colonize after construction is finished and the site is returned to its pre-construction conditions.

A beneficial impact is expected to the diamondback terrapin. The heavy erosion along the southern shoreline prevents the development of sand beaches and mud flats, the primary terrapin habitat. By reducing erosion, these conditions are expected to improve, creating the shorelines necessary for terrapin habitat.

6.2.4.c Avian Species. During construction, noise and disturbance may temporarily force avian species to relocated. Shore birds will likely relocate to other nearby areas during this period. However, these impacts are expected to be temporary and minor. Construction noise is not expected to disturb the nesting areas. Construction will be in the open-water, over 3000 ft. from the nearest rookery. The one-acre staging area on Swan Island is expected to force a number of individual organisms to relocate to other sections of the island. However, these impacts are expected to be minor and temporary. Construction will be timed to avoid impacts to nesting sites during the breeding season, thus, short-term impact are unavoidable and are expected to be temporary and minor.

The project is expected to have a large, long-term positive impact on avian species. The project will protect the marsh and the interior rookeries, providing stability to the rapidly eroding island. The project will also protect SAV and mudflats, sources of food for a variety of shore birds, wading birds, and migratory waterfowl. In addition, the offshore structures will likely become resting areas for a variety of gulls and pelicans.

6.2.5 Water Quality

Temporary local impacts to water quality as result of increased turbidity are expected from construction and bottom disturbance. This will fall outside the range of natural conditions along the shoreline. However, the sediment will settle after construction and turbidity conditions will return to normal after three months. The long-term water quality is expected to be improved through the anchoring of the marsh sediment. Care will be taken to prevent spills of gasoline or lubricant oil from construction equipment. If spills occur, the appropriate authorities will be contacted and clean up actions put into place.

All best management practices will be used during construction. No extra turbidity will occur after construction.

The sediment generated during construction is expected to occur from two sources, the construction of the breakwaters and the dredging for borrow material. The sediment generated from the breakwaters is expected to be relatively minor and short-term, with settlement within a few weeks of stone placement. The sediment is expected to stabilize while an equilibrium is established behind the breakwaters. The backfill behind the breakwaters will speed the stabilization process. The suspended sediment from construction, once resettled, is not expected to interfere with SAV regeneration or damage shallow water habitat. Rather, the breakwaters are expected to provide long-term benefits to water quality, by anchoring the sediment, removing the main source of local sediment supply.

The second source of suspended sediment and turbidity is from the dredging for borrow material. The dredging will use all known best management practices, including designing the borrow site to minimize impacts, including the minimization of suspended solids. The material suspended during the dredging is expected to settle within a few months of dredging. As within the Rhodes Point Channel, the borrow site is expected to fill within several years of construction, returning it to natural conditions. The dredging is unavoidable, and impacts are expected to be minor and temporary.

The project is expected to have long-term beneficial impacts on water quality, although the exact amount is difficult to measure. By reducing marsh erosion, the project will help anchor the fine grained, nutrient-rich marsh sediment and prevent it from entering the local water column. The expected result is an increase in water clarity, resulting from a decline in nutrient levels and total suspended solids, allowing more light to reach the Bay floor. More light is expected to encourage SAV germination, which will further help anchor Bay bottom sediment and act as a nutrient sink, absorbing nitrogen and phosphorous from the Bay. Increasing the size and quality of the seagrass beds is likely to have long-term benefits to water quality and the overall quality of the aquatic ecosystem.

6.2.6 Uplands

Uplands within Martin National Wildlife Refuge support important colonial waterbird nesting colonies and act as an important part of the Smith Island ecosystem. The project will be constructed in open water and is not expected to have any adverse impacts to the upland hammocks, located nearly ½ mile away from the construction areas.

The stabilization of the sediment and associated protection of the marsh will incidentally help preserve the uplands from erosion, which would gradually undermine the high ground. By reducing erosion and restoring some stability, the uplands are expected to continue to function as breeding sites and will be able to maintain their integrity. Thus, a long-term beneficial impact to the uplands is expected.

6.2.7 Hydrology and Hydrodynamics

The project is expected to alter the prevailing wave energy, reducing the force of the waves against the marsh. The waves are expected to break against the stone breakwaters, providing a quiescent zone landward of the structures. These changes are designed to protect the resources of the island as discussed below and in Appendix E.

6.2.7.a Wind Conditions. The breakwaters are not expected to have any impacts on the prevailing wind direction. The structures are low, only 3.5 feet above MLLW, and will not block the prevailing westerly winds. No impacts to wind conditions are expected.

6.2.7.b Wave Conditions. Wave energy is expected to be reduced along the western shoreline and coves of Martin National Wildlife Refuge. At present, the wave energy is producing extensive erosion and preventing SAV germination. The breakwaters are designed to reduce the wave energy, dramatically reducing erosion and creating quiescent waters behind the structures. Clean fill will be used to tie the structures into the existing shoreline, with quiescent water between the structures.

The breakwaters will still allow storm surges and other large wave events to overtop the structures. However, the waves will be broken offshore of the marsh, dramatically reducing the energy without altering the marsh hydrology. This will result in long-term, beneficial impacts to the island ecology.

6.2.7.c Tidal Currents. The breakwater system is not expected to have adverse effects on the tidal currents. The segments between the structures will allow tides to reach the marsh, preserving the tidal hydrology within the marsh.

The project is expected to prevent tidal breaching of the marsh and protect the interior coves from increased scour and sedimentation. Tidal currents will be restored to their pre-breach condition, reducing the energy within the coves and promoting the conditions for SAV growth.

6.2.7.d Sedimentation and Erosion. Sedimentation is a natural process, however marsh breaching has dramatically increased sedimentation within Big Thorofare and within Back Cove. These systems have had large influxes of fine, nutrient-rich sediment stemming from the eroded marsh soils entering the protected areas. As the sediment-laden water enters the coves, it deposits the sediments, changing the substrate and damaging SAV habitat. The result has been a serious degradation of the internal areas.

The project components are designed to reduce erosion, thereby reducing the sedimentation within Big Thorofare and the coves. Because the structures will maintain the natural shoreline, allowing for accretion behind the structures, no negative impacts from sedimentation or erosion are expected. The breakwaters will help anchor the marsh sediment, preventing erosion and stopping the sediment from entering the water column.

Thus, the project will help prevent the problems associated with erosion and sedimentation, providing a large beneficial impact to the area.

6.3 CULTURAL RESOURCES

No impacts to the cultural resources of Smith Island are expected. The structures will be built in open water in areas that historically were fastland. The land near the projects is uninhabited, away from any prevailing historic sites. A letter of coordination from the Maryland Historic Trust is included in Appendix B.

6.4 SOCIO-ECONOMIC RESOURCES

No negative impacts to the socio-economic resources of the island are expected. Some positive benefits may be gained through increased tourism or additional revenue generated by increased populations of blue crab and other commercially important species in and around the SAV beds. By preventing erosion along the Western Shoreline, Ewell will continue to be protected from the open Bay and the sedimentation of the navigation channels in the area should be reduced.

6.4.1 Land and Water Use

The project is expected to impact 23.5 acres of shallow water habitat, which will be converted into marsh. An additional, 2.97 acres will be converted to stone structure, making the cumulative impacts equal to 26.47 acres. Furthermore, approximately 68,000 cubic yards of material will be borrowed from the beds of fine sand, located 1500 feet off-shore of the Western Shoreline (Figure 6.1).

The borrow site will be used in long, three foot deep sections, designed to minimize environmental impacts to the shallow water. The shallow dredging patterns will prevent the development of a deep pool, and allow the shallow ditches to be filled relatively quickly by the prevailing currents. The borrow sites will avoid known oyster bars, historic SAV areas, or other significant bottom features, minimizing impacts to the shallow water areas. Nonetheless, the borrow sources are likely to disturb the existing benthic communities during construction and force resident fish species to migrate to other areas. However, both of these impacts are expected to be temporary and recolonization is expected within a year of the dredging. In addition, based on survey data taken at Sheep Pen Gut, it is predicted that the offshore borrow sites will fill within two years of being dredged, making impacts minor and temporary.

The wetland creation and breakwaters will impact 26.5 acres of crab fishing habitat. Fill behind the structures will convert the crab and fish habitat to wetlands, removing crabbing opportunities. However, due to the extensive shallow water in the area and the ability of crabs and fish to migrate, these impacts are expected to be minor.

In addition, the project is expected to have a long-term beneficial impact to SAV within Big Thorofare, providing additional crab and fish habitat within the island. No adverse impacts to land use are expected.

Swan Island, currently used as a dredged material disposal site, will be used as a staging area for the stockpiling of construction materials and equipment. The island remains a wetland, although it is a disturbed site. The site was chosen because it is already disturbed and allows construction to avoid the areas of pristine marsh, located on the mainland of the refuge. Construction will temporarily impact the wetland vegetation and the resident avian species. The avian species are expected to relocate to other areas of the marsh. Following construction, the island will be returned to its pre-construction condition. As a result, adverse impacts to Swan Island from construction are unavoidable, and these impacts are expected to be temporary and minor.

6.4.2 Population

No adverse impacts to the population of Smith Island are expected. By restoring geologic integrity to the island, potential benefits in recreation and tourism may help support the island population, providing some beneficial impacts to the community. Navigation improvements are possible due to decreased shoaling in Big Thorofare.

The project was developed with extensive community support and they highly support the project.

6.4.3 Employment and Industry

By restoring geological integrity and helping restore SAV and marsh habitat, it is hoped that opportunities for tourism, recreation, and commercial fishing will increase, providing additional sources of employment for the Smith Island community.

The proposed project will help restore integrity to the wildlife refuge as well as the internal coves, providing additional resources for the island community. No adverse impacts are expected.

6.4.4 Education

No adverse impacts to the educational system of the island are expected. Rather, long-term benefits may be seen through increased understanding of the relationship between the island community and the Wildlife Refuge. The CBF's Bay education center is expected to benefit, by maintaining access to the marsh and SAV beds within Big Thorofare.

6.4.5 Transportation

No adverse impacts to transportation are expected. The breakwaters will be located 30 to 100 feet offshore and are not expected to be a navigational hazard. The structures are not expected to impact access to the channels within Big Thorofare and are not expected to have any negative impacts within the interior of the island. By reducing sedimentation within Big Thorofare, beneficial impacts may occur by reducing shoaling within the interior channels.

6.4.6 Environmental Justice

No adverse impacts under Executive Order 12989, dated February 11, 1994 (*Environmental Justice in Minority Populations*), are expected since the recommended projects are not near the populated areas of Smith Island. Further, there are no minority communities located on Smith Island. It is anticipated that all of the island's residents will benefit from the proposed projects through the economic opportunities from increased natural resources.

6.5 RECREATION AND TOURISM

No adverse impacts to recreation and tourism are expected. Beneficial impacts may result from closer collaboration between the islanders and the National Wildlife Refuge. Benefits are expected through increased recreational fishing in Big Thorofare. Long-term opportunities for eco-tourism may exist in the future.

6.6 RARE, THREATENED AND ENDANGERED SPECIES

Although a few transient Rare and Threatened species are know to visit Martin National Wildlife Refuge, no impacts to rare, threatened, or endangered (RTE) species are expected. By protecting the Smith Island system from degradation, it is hoped that RTE species will continue to colonize the refuge. By protecting the Smith Island ecosystem, there may be beneficial impacts to the Northern Harrier and Black Skimmer, both state listed rare species. The Planning Aid Report, prepared by the FWS, serves as the letter of coordination. The report is included in Appendix A, and provides details on RTE species known to visit Smith Island. If RTE species are found during construction, the appropriate agencies will be notified and additional coordination will follow.

6.7 PRIME AND UNIQUE FARMLAND

Because there is no farming on Smith Island, the project is expected to have no impacts on Prime and Unique Farmland.

6.8 HAZARDOUS, TOXIC AND RADIOACTIVE SUBSTANCES

No hazardous, toxic, radioactive substances are found within the project footprint. The majority of the area is in pristine condition and no impacts are expected. Best management practices will be used during construction to minimize oil and gas spills from equipment. If spills occur, or HTRW materials are found, appropriate measures will be taken to insure adequate clean up or removal.

6.9 AIR QUALITY

Aside from emissions generated by construction equipment, no impacts on air quality are expected. The vehicle emissions are expected to be minor and temporary. Following construction, the structures will be passive and will not generate any additional air pollutants.

6.10 NOISE

Noise during construction will be produced by construction equipment, such as dredges, bulldozers, trucks, and workboats. Smith Island area is known to have extremely valuable colonial nesting bird populations and minor, temporary impacts to breeding birds may occur. For this reason, environmental windows will be used when scheduling construction activity to avoid breeding seasons. A winter construction schedule would avoid these impacts. Nearby wading birds may temporarily relocate to other areas of the island.

Following construction, the structures will be passive, with no long term noise impacts. The structures are likely to become resting areas for pelicans and other shore birds.

6.11 IMPACTS BY PROJECT AREA

6.11.1 Western Shoreline

The Western Shoreline is the longest project component, and will impact approximately 8.73 acres of shallow water. Approximately 54,000 $ft.^2$ (1.23 acres) of bottom will be converted to stone structure. The impacts will be from the project footprint and from the fill behind the structures. The fill will be converted into wetlands and will protect the existing marsh from further erosion. Apart from the minor impacts to shallow water, there is expected to be a long-term beneficial impact to the Smith Island ecosystem.

Approximately 15,000 cubic yards of fill are needed for the recommended plan, which will be taken from the shallow water approximately 1500 ft. offshore of the western shoreline. The fill will be taken in long, shallow pockets, approximately 3 feet below the existing bottom. Removing the borrow material in this fashion will encourage shoaling of the borrow sites. Impacts are expected to be minor and temporary to shallow-water habitat, and result in a large beneficial impact to the overall ecosystem. No impacts to EFH are expected.

The Western Shoreline plan is expected to help preserve approximately 135 acres of marsh over the next 50 years and help restore approximately 1,500 acres of SAV within Big Thorofare. By stabilizing the Western Shoreline, the most rapidly eroding section of the island, it is hoped that water quality will improve throughout the Smith Island area, helping regenerate SAV and reducing nutrients and solids in the water column.

6.11.2 Fog Point Cove

The project component at Fog Point Cove is expected to protect 29 acres of marsh, 34 acres of SAV, and protect terrapin nesting sites. The plan will convert 18,000 $ft.^2$ (0.4 acres) of shallow water to stone breakwater, combined with 3.8 acres of marsh created behind the structure using 13,000 cubic yards of material from the borrow site. These adverse impacts are expected to be temporary and minor, and will result in a large beneficial impact to the marsh and SAV within the cove. The plan is not expected to have any adverse or long-term impacts on EFH or other aquatic communities. Instead, it is expected to help protect the island ecosystem, with benefits to the marsh, SAV, and mudflats of the island. In addition, the plan is expected to have a beneficial impact on diamondback terrapins, which are know to nest in the quiescent waters of the cove.

6.11.3 Back Cove

The project component at Back Cove will convert 58,500 $ft.^2$ (1.34 acres) of shallow water to stone breakwaters, and convert 12.2 acres of shallow water to tidal marsh, using 40,000 cubic yards of backfill from the borrow area off of the Western Shoreline. These adverse impacts to shallow water are expected to be temporary and minor, and fish and benthic species are expected to re-colonize after construction, within the quiescent water of the cove. The recommendation is expected to protect approximately 80.5 acres of marsh over the next 50 years and add 12.2 acres of marsh to the island. It is also expected to protect 236 acres of SAV and help an additional 200 acres to re-establish. The extensive SAV beds are expected to generate benefits to numerous fish and crab species within the cove and help protect the shoreline for terrapin breeding sites.

6.11.4 Terrapin Sand Cove

Due to the expense of restoring Terrapin Sand Cove, combined with the uncertain benefits of the action, the restoration of Terrapin Sand Cove is not recommended. The cove is nearly completely eroded and is expected to further degrade, soon becoming unrecognizable as a cove. Because of the severe degradation, the expense of restoration is cost prohibitive.

The southwest section of the Back Cove project is expected to provide protection to the northern shoreline of Terrapin Sand Cove. While this plan is not expected to fully restore Terrapin Sand Cove, it is expected to reduce the overall impacts of continued degradation and provide a stable shoreline, allowing a new equilibrium condition to re-establish.

6.12 CUMULATIVE IMPACTS

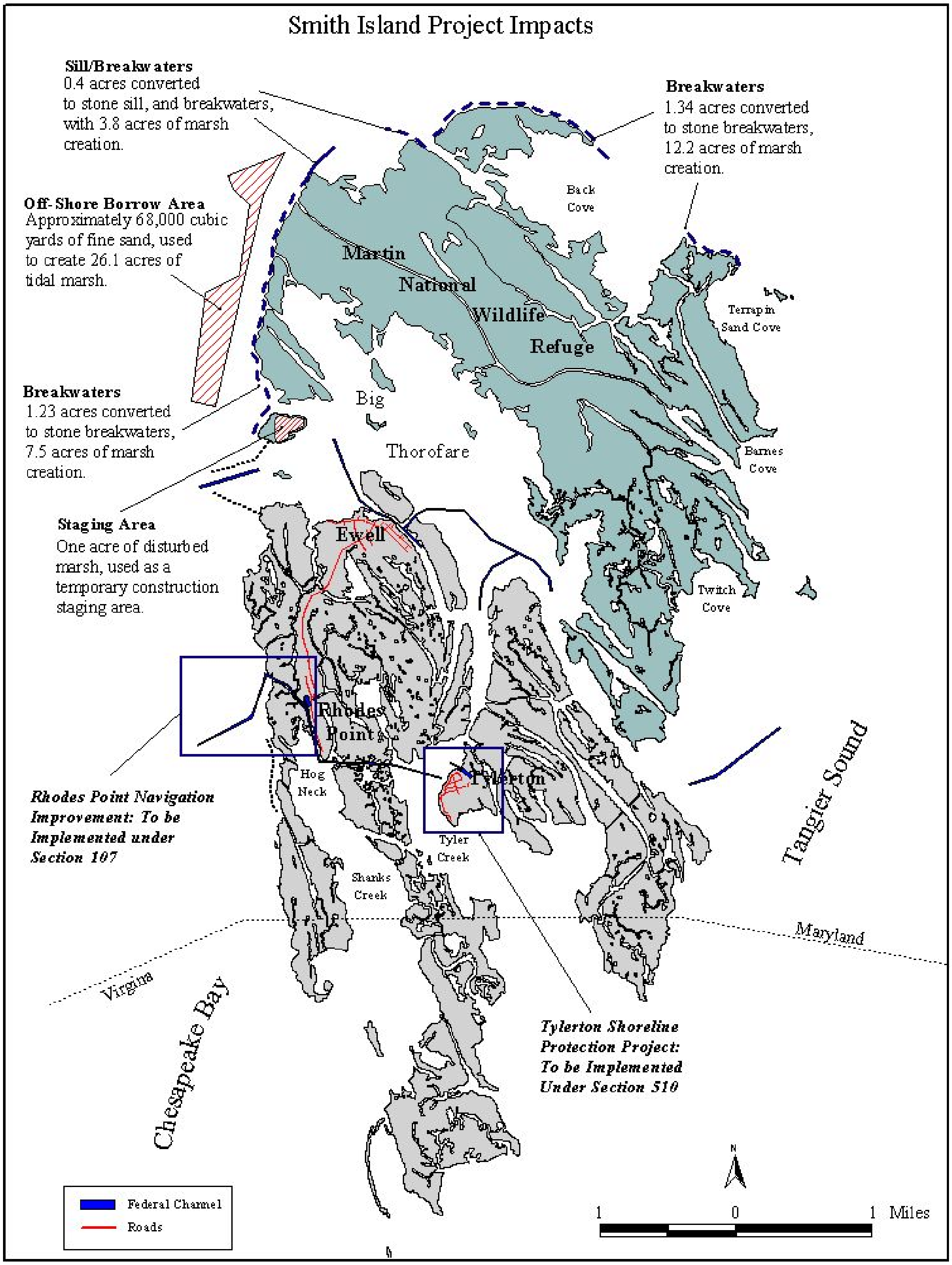
The Smith Island project is expected to have a long-term, beneficial impact to the island ecosystem, providing direct and incidental benefits to the SAV, emergent marsh, and upland areas, and to the associated fish, avian, and benthic species that reside within these habitat areas. The blue crab, black duck and other migratory waterfowl, shorebirds, and diamondback terrapin are expected to increase in population. In addition, the quality of the Smith Island system is expected to increase, by limiting the disturbance associated with the extensive erosion. The project is expected to improve the ecosystem by reducing marsh erosion and encouraging SAV regeneration. Through the anticipated reduction in turbidity and by anchoring the shoreline, the waters surrounding Smith Island will be more conducive to SAV growth, which will further reduce nutrients and slow the wave energy, providing long-term benefits to the system. In addition, if the catastrophic marsh erosion is reduced, the marsh is expected to generate peat, allowing it to maintain its elevations against future sea-level rise.

The project is expected to convert 29 acres of shallow water into stone and marsh, and require the borrow of 68,000 cubic yards of sand. The environmental impacts from this project are shown in Figure 6.1. Despite the overall net loss of shallow water habitat, the project is expected to have a large beneficial impact on the quality of the remaining shallow water areas, by helping to restore SAV within the Smith Island system. Thus, quantity, in terms of acres, is expected to slightly decline, but the quality of over 1500 acres of shallow water is expected to improve. Overall, the project is expected to benefit over 2000 acres, making it an extremely valuable project within the Chesapeake Bay watershed.

Additional actions from the Corps of Engineers include using dredged material from the Big Thorofare channels to continue to protect Hog Neck, the Tylerton Shoreline Protection Section 510 Project, and the Rhodes Point Navigational Improvement study. Each of these activities is expected to increase the viability of human and biological habitation on Smith Island. The Tylerton and Rhodes Point projects, outgrowths of the feasibility study, are designed to help meet the needs of the local communities, while this study is designed to protect and restore the ecosystem. Cumulative impacts include the stabilization of many sections of shoreline, although hardened shoreline has been kept to a minimum, solely within the local town centers. Stabilization will decrease the level of solids within the system, helping to restore SAV and preserve the pristine marsh. Furthermore, the combined actions will continue to allow the waterman culture of Smith Island to remain viable. Navigational improvements will allow continued access to the mainland and to the resources of the Bay, while it is anticipated that the environmental restoration will help improve these same resources and protect them from degradation.

A summary of regulatory compliance information, including all state and federal regulatory requirements, is attached in Appendix A. During PED, all necessary permits will be obtained prior to construction. These permits include a water quality certification, an erosion and sediment permit, and other federal regulations. In general, the study team has worked closely with the regulatory community and they support the project and the study's findings.

Figure 6.1: Project Impacts on Smith Island.



Thus, the cumulative impacts of the Smith Island project are expected to be long-term and positive, for both the human inhabitants and the local ecosystem. The project, in conjunction with other USACE projects, is expected to help preserve the integrity of the Smith Island ecosystem and community. Smith Island represents a unique mix of tidal marsh, scattered uplands and extensive SAV beds. The island supports a human community that dates to the mid-1600s, and actively draws its livelihood from the resources of the Chesapeake Bay. USACE projects at Tylerton and Rhodes Point, in conjunction with the channels maintained throughout the area, are designed to help these unique communities maintain their integrity and access the resources of the Bay and the mainland. Nonetheless, both the human and wildlife communities are impacted by the severe erosion and habitat degradation. The Smith Island project is designed to help maintain the physical and biological integrity of the island, allowing it to maintain itself into the 21st century.

6.13 SUMMARY OF REGULATORY COMPIANCE

The Smith Island Restoration and Protection Project complies with all federal and local regulatory statutes. A summary of the regulatory compliance checklist is included in Appendix A. In addition, a water quality certificate and Coastal Zone Management (CZM) consistency letter is expected to be issued by the State of Maryland prior to construction. The State of Maryland supports the project and off-shore breakwaters, by preserving the natural shoreline, are consistent with the State's coastal zone management plan and water quality initiatives. No wild and scenic rivers nor prime and unique farmland are found on the island. Thus, the project is exempt from the above regulations.

Section 7

PLAN IMPLEMENTATION

This section provides an overview of the major requirements for project implementation, covering the upcoming phase of PED as well as through the construction phase. Implementation of the recommended plan will require a number of commitments on the part of the USACE and the project's non-Federal sponsors to realize the full benefits of the plan. Project implementation will proceed in two phases: PED and construction.

The project implementation process is summarized in a project management plan (PMP). The PMP covers activities to be accomplished during the PED and construction phases of the project by the Baltimore District, U.S. Army Corps of Engineers, and the non-Federal sponsors. The PMP summarizes the scope, schedule, budget, and responsibilities for the actions to be accomplished, as well as the management structure and Federal/non-Federal partnership roles. A preliminary PMP is being drafted and will be finalized once PED negotiations have been completed. The PMP is a management tool for use by the District and the non-Federal sponsors, and as such, will be revised as needed to accommodate changes as project implementation proceeds.

7.1 CONGRESSIONAL AUTHORIZATION

In order for the Smith Island environmental restoration project to be constructed, authorization must come from Congress as part of a Water Resources Development Act (WRDA) bill. The process dictates that once the final feasibility report is completed, Headquarters of the USACE prepares a Chief of Engineer's Report. This report provides the Assistant Secretary of the Army (ASA) with the views, findings and recommendations on project authorization. Once the Secretary's office has reviewed the report and finds that authorization, implementation, and budgeting of the project is consistent with applicable laws and policies, it is forwarded to the Office of Management and Budget (OMB). OMB supervises and controls the administration of the budget and issues policies for the Executive Branch. After OMB has approved the project, the ASA forwards the project to Congress for implementation. Congress then refers the report to the House Committee on Transportation and Infrastructure and the Senate Committee on Environment and Public Works for inclusion in a WRDA bill. Typically, these bills are enacted every two years. If this project is to be implemented under WRDA, the earliest that authorization could be realized is WRDA 2002, with construction then occurring in 2005 (starting October 2004).

7.2 NON-FEDERAL SPONSOR

For the feasibility phase of the Smith Island Environmental Restoration and Protection project, the Md DNR, the MDE, and Somerset County acted as the non-Federal sponsors for cost-sharing purposes. Specifically, these agencies provided the cash and in-kind service contributions, and represented the State of Maryland and Somerset County in all study activities. For the PED and construction phases, the State of Maryland and Somerset County are expected to continue direct project involvement. The State of Maryland has indicated their intent to proceed with the next phase of project implementation and to provide the non-Federal cooperation required for project implementation. As such, letters of intent have been requested from the non-Federal sponsor and will be included in the final feasibility report.

7.3 PROJECT COST-SHARING AND IMPLEMENTATION COSTS

For Corps Civil Works projects, an important process is the assignment of costs among the various project purposes and the implementation authority. The activities comprising the recommended plan will serve the needs of environmental restoration through erosion control, wetlands protection and habitat creation only, and no other water use or purpose is currently identified. Accordingly, all costs will accrue to the environmental restoration project purpose. Funding for USACE participation in civil works environmental restoration projects occurs under the authority of Section 210 of the WRDA '96 (Public Law 104-303). In this section, the PED and construction cost-sharing that was earlier established by Section 103 of WRDA '86 was revised to 65 percent Federal and 35 percent non-Federal.

The implementation cost of the recommended plan is currently estimated at $7.4 million and reflects November 2000 price levels with no price escalation. Utilizing the 65-35 formula for cost sharing, the Federal share of the baseline cost is $4.8 million, and the non-Federal share is $2.6 million. The cost estimate includes values for lands and damages, construction of the fish and wildlife habitat features, planning, engineering, design, and construction management. A site-by-site summary is detailed in Table 7.1.

Price escalation may occur during the design and construction phases. To provide both the Federal government and the non-Federal sponsors with a project cost estimate that reflects anticipated price escalation, a fully funded estimate has been developed. This estimate is based on standardized escalation factors provided by the OMB for future years. The fully funded estimate is summarized in Table 7.1. As noted, the fully funded cost for the project is $8.9 million, of which $5.8 million will be allocated to the Federal government and $3.1 million will be a non-Federal responsibility.

Table 7.1: Smith Island Environmental Restoration and Protection Project Cost Summary

Account	Feature Account/Site Description and Location	Baseline Estimate	Fully Funded Estimate
01	Lands and Damages	$1,400	$1,600
06	Fish and Wildlife Facilities		
	Western Shoreline	$2,422,000	$2,943,000
	Fog Point Cove	$1,132,000	$1,375,000
	Back Cove	$2,728,000	$3,314,000
	Monitoring	$50,000	$50,000
	Subtotal	$6,332,000	$7,682,000
30	Planning, Engineering and Design	$734,000	$799,000
31	Construction Management	$375,000	$483,000
	Total Construction Cost	$7,442,400	$8,965,600
	Project Implementation Cost-Sharing		
	Federal Share (65%)	$4,837,600	$5,827,600
	Non-Federal Share (35%)	$2,604,800	$3,138,000

NOTES:
1) Baseline construction cost estimate prepared in accordance with ER 1110-2-1302 using the Corps of Engineers M-CACES program; values are in November 2000 price levels.
2) Fully funded estimate assumes unconstrained Federal and non-Federal funding.
3) Subtotals may not agree, due to rounding.

7.4 PROJECT SCHEDULE

Project implementation is expected to begin in May 2001 following approval of the feasibility report and signature of the Division Engineers Notice, and execution of a PED agreement. The PED phase is planned for the period of June 2001 through December 2002. Authorization for construction should be received in WRDA 2002, which will be for FY 2003 and subsequently, construction funding could be budgeted in FY 2005. Given these constraints, negotiation of the PCA could commence in early 2003; completion of the negotiations is expected in the summer of 2003. PCA execution is anticipated in late 2004.

Based on the availability of funding, the construction phase could begin in Federal FY 2005. The only real estate required for project implementation is a permit from USFWS. Discussions between the State and USFWS regarding the permit have already been initiated. It is expecting that real estate can be certified one month after the PCA is executed. Following this, the construction contract process would be initiated. The construction contract is currently scheduled to be awarded in the summer 2005, with completion of the physical construction expected in the summer of 2007. Monitoring activities are planned to continue through 2011. A summary of the project milestones is listed in Table 7.2.

Table 7.2: Major Milestones - PED and Construction Phases

FY 01	Issue Division Engineer's Notice Execute Agreements for PED Phase Initiate PED Phase
FY 02	Prepare Plans and Specifications
FY 03	Final Plans and Specifications Completed Project Authorization in WRDA 2002 Initiate PCA Negotiations Preparation of PCA Package
FY04	Submit PCA Package Approval of PCA
FY 05	Funding for Construction Received Execute PCA Complete Real Estate Acquisition Advertise and Award Construction Contract
FY 06	Initiate Physical Construction
FY 07	Complete Physical Construction
FY 08-11	Continue Project Monitoring

7.5 NON-FEDERAL COOPERATION REQUIREMENTS

The local cooperation requirements for implementation of the proposed environmental restoration projects have been discussed with the non-Federal sponsors. The potential sponsors understand that they will be required to provide assurances that they have the legal authority to enter into preconstruction engineering and design and project-cooperation agreements, and are able to execute these responsibilities.

The non-Federal requirements for implementation of the Smith Island Environmental Restoration and Protection River project are:

a. Provide 35 percent of the separable project costs allocated to environmental restoration as further specified below:

(1) Enter into an agreement, which provides, prior to execution of a project cooperation agreement for the project, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(5) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental restoration.

b. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government.

c. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

d. Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

e. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

f. Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

g. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

h. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

i. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

j. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

k. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

m. Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

n. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement.

o. Do not use Federal funds to meet the non-Federal sponsor’s share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

Section 8

AGENCY COORDINATION AND PUBLIC INVOLVEMENT

8.1 PURPOSE OF PUBLIC INVOLVEMENT AND AGENCY COORDINATION

The purpose of public involvement is to open and maintain channels of communication with the public so that their views can be fully considered in the planning process. The "public" may include any individuals, organizations, or units of government that might be affected by or interested in the results of a planning process. For projects on Smith Island the "public" includes current island residents – both native residents and part-time vacation home-owners, non-residents (such as natives who have moved to the mainland), and various levels of government agencies and offices. Somerset County is the most local level of government that serves the island and state environmental management and regulatory agencies, such as the MdDNR and MDE, also have regular contact with and important interests on the island. At the Federal level, the USFWS manages half of the island as the Martin National Wildlife Refuge. There is also considerable interest at the national level on the part of the National Park Service and Congress, based partly on the island's cultural resources.

USACE policy requires that the public be informed about proposed USACE activities, that the public's desires, needs and concerns are made known to decision-makers, that consultation with the public is accomplished before decisions are reached, and that the public's views are considered in reaching decisions. USACE planning guidance requires that studies should be conducted in a way that achieves the understanding, trust, and mutual cooperation of the public and provides opportunities for the public to participate.

Public involvement on Smith Island included the full range of groups and representatives who participated in the study. Preparatory actions by the reconnaissance study team included reading articles, books, and documents written about Smith Island. Conversations with Smith Island residents followed the literary introduction to the Island and its problems. Then, meetings were held in each town, notices about the study were mailed to residents with comment cards, residents were interviewed by phone and in person, old reports were read, and interested agencies and individuals were contacted.

One of Smith Island's defining characteristics is the lack of a formal governing body. The Methodist Church serves some of the functions of a government, such as collecting funds to pay for community improvements and services. Because there are no elected representatives, coordination between the study team or other non-island residents and the local population is necessarily direct. Off-islanders (the local term is "foreigners") conduct business on the island by communicating directly with island residents who may be interested or involved in the task or issue, rather than dealing with officials. For the purpose of conducting study activities, team members began public involvement activities by contacting representatives from the Crisfield and Smith Island Cultural

Alliance and the USFWS. The team was directed to several individuals from each of the three communities. The earliest contacts provided specific information or guidance and also provided leads to further sources of information. As the study progressed, the team came to rely on many of the local residents for various types of information.

The following sections provide a brief overview of some of the primary public involvement efforts. A more detailed discussion of the public involvement for this study is contained in Appendix B.

8.2 DESCRIPTION OF COORDINATION

Major public involvement activities during the study included announcing the study initiation, identifying the public – individuals, organizations, government agencies and offices – that might be affected by or interested in the study, using input for the development and evaluation of alternatives and for the selection of the recommended plan.

8.2.1 Reconnaissance Phase Agency Coordination and Public Involvement

The reconnaissance study was initiated in June 1996. In July 1996, study initiation letters were sent to interested agencies and elected officials to solicit input, and a public notice was issued. The USFWS, the State of Maryland (MdDNR and MDE), and Somerset County have been active participants in the study process since the study initiation. USFWS representatives, including the island-based manager of the Martin Refuge, attended a number of study team meetings to provide an agency perspective. Furthermore, the interested state environmental agencies (MdDNR and MDE) are non-Federal sponsors, and, therefore, had continual input throughout the problem identification and plan formulation processes.

During the reconnaissance study the team conducted an exhaustive search for public as well as agency input. Within the first few months of the study initiation the study team visited Smith Island several times and conducted meetings in each of the three towns and held an island-wide community meeting. The team discussed the study with various interested groups and interviewed individuals to gather historical information and opinions as to what problems existed. One of the first products of the public involvement process was a compilation of problems, some that USACE had authority to address, and many that were not in the Federal interest. The study team focused on formulating potential plans to solve problems such as environmental degradation, erosion, and navigational impediments. These potential solutions were discussed with island residents and potential non-Federal sponsors before recommendations were made. More detail on the reconnaissance public involvement efforts, including the various meetings on the island, can be found in the Smith Island Environmental Restoration and Protection reconnaissance study.

8.2.2 Feasibility Phase Agency Coordination

Agency coordination efforts included meetings and discussions with, and presentations to USFWS, the Maryland Historical Trust, MdDNR, the Chesapeake Bay Foundation (CBF), Somerset County government, MDE, and others. Due to the exhaustive coordination done during the reconnaissance study, many relationships were formed that continued through the feasibility process, oftentimes in a more informal manner. At the beginning of the reconnaissance study, a steering committee was formed to provide guidance and support for the project. The agencies and individuals that participated at that early date have maintained their involvement and support of the projects on the Island. Participants have included representatives of the State Historic Preservation Office, Department of Natural Resources, US Fish and Wildlife Service, Maryland Department of the Environment, US Environmental Protection Agency, National Marine Fisheries Service, National Park Service, and the Somerset County Commission, Congressional representatives, elected officials, and community leaders from each of the three towns on Smith Island.

During the feasibility study, agency input was solicited as part of NEPA coordination. A study initiation letter was sent to agencies in October 1998. The letter requested that the agencies provide the USACE with any information about the potential projects and any concerns that they may have with the potential proposals. Further, a point of contact was requested for future coordination. On March 3, 1999, the study team held a site visit and meeting on Smith Island for the interested State and Federal agencies. Representatives from National Marine Fisheries Service, USFWS, MDE, MdDNR, Somerset County and the Corps attended. EPA was invited but did not attend. During the site visit, meeting attendees were shown the proposed project areas and potential solutions were discussed. Comments and ideas from the agencies were used during the design of the preliminary alternatives.

An Executive Committee meeting was held on March 26, 1999, in the Baltimore District Office to discuss the progress of the study and to receive approval for consideration of the Tylerton Project under Section 510 of WRDA 1996. At the meeting, approval was granted by the sponsors to pursue Section 510. Further, the Committee recommended that the team continue to pursue consideration of the Rhodes Point Project under Section 107 of the River and Harbor Act of 1960.

An Agency Coordination Meeting, held at the Corps District Offices on October 7, 1999, to present the project alternatives that had been developed in response to the meeting on the Island in March. The issue of the borrow material was brought up and the team agreed to continue to study it throughout the feasibility phase and during PED if necessary. Further, USFWS and the State offered their opinions as to what areas were to be considered as priority for protection.

This report will be reviewed for policy compliance, and by the sponsors, before public review. This draft report will be distributed to the agencies for review and comment as part of the public review before being finalized and transmitted to Headquarters, USACE for submission to Congress.

8.2.3 Public Involvement Activities and Results

Good public involvement was critical to the Smith Island studies. Standard public involvement techniques, such as large public meetings, press releases, and extensive newsletters, were modified to fit the local requirements, which included a small population, an extremely high level of interest, and a history as a non-government inclined population. In general, the result of the modifications was that there was a high degree of interaction between the study team and island residents and more than the usual number of one-on-one or small group discussions were held.

Several major public involvement tasks, such as identifying the public and scoping out the islanders' ideas about the needs and potential solutions to problems, were accomplished during the reconnaissance study, completed in May 1997. Following final approval of the reconnaissance report, a Public Notice announcing the initiation of a feasibility study was mailed in October 1998. Four potential plans were originally included in the feasibility study: shoreline protection and stabilization at Rhodes Point, erosion and storm damage protection at Tylerton, repairs/breach closures along the northwest shoreline of the Martin Refuge, and restoration of the coves at the north shore of Martin Wildlife Refuge. However, the Tylerton component was "pulled out" of the larger study and received separate funding through the Section 510 program and the Rhodes Point portion of the study was pulled out and considered under Section 107 Small Navigation Program as discussed previously.

In addition to the Public Notice, the feasibility study initiation was announced to approximately 400 individuals, organizations, and agencies through a brief newsletter mailed in June 1999. During the 18 months after the first newsletter was mailed, four additional newsletters and several flyers were sent to island residents and other interested parties. The newsletters included project status reports, described technical work conducted on the island, and announced community information meetings.

The high level of public involvement established during the reconnaissance phase was continued throughout the feasibility phase. In addition to the newsletters, visits to the island, notes, e-mail, and phone conversations maintained a steady two-way communication flow. Informal communications between local residents and team members conducting technical tasks on the island also became an effective form of public involvement. Several highly interactive community information meetings were held at both the Rhodes Point Community Center and the Tylerton Methodist Church to provide status reports, identify problems, present alternatives, discuss other issues, and to give and receive information.

Communications and meetings included the following, however, it must be noted that local residents are in frequent contact with team members and information is passed informally. Further, during every visit to the island, the team made a practice of meeting with certain citizens who are active in the community to keep them informed of progress and to receive input:

On July 1, 1998, the study team held an initiation meeting on the Island to discuss the goals and timeline for the feasibility study. This was the first meeting at which the County and the State of Maryland were officially present as sponsors. Schedules were discussed for when the final recommendations would be completed and project implementation could begin. The implementations of the Tylerton and Rhodes Point projects were addressed.

The study team provided the first feasibility status report for island residents in a June 1999 newsletter (Issue #1) and at a public meeting held in Rhodes Point on July 14, 1999. The team presented information on technical investigations for the overall study, reported on the separate funding received and accelerated schedule for the Tylerton plan, and on the continuing efforts to identify separate funding sources for the Rhodes Point recommendation. A newsletter similar to the one sent to island residents in June was prepared specifically for agencies and government offices and was mailed in July 1999. The purpose of the agency newsletter was to provide more complete background information for individuals and offices that did not have regular involvement with the island and the proposed project. The appearance of two editions of a newsletter close to the same time was somewhat confusing, so only single editions of future newsletters were prepared.

Additional coordination was conducted in the fall of 1999 with representatives of the Washington D.C. Woodrow Wilson Bridge (WWB) project. Members of the Smith Island and WWB study teams explored the possibility of using material excavated from the bridge project as fill for wetland creation at Smith Island. After several months of discussion and evaluation, it was decided that the material would not be placed at Smith Island.

Study team members visited Tylerton on October 25, 1999 to discuss specific elements of that project component, such as construction access and real estate easements.

In December 1999, Issue #2 of the newsletter was mailed to island residents. The newsletter provided a status report on both the Tylerton action and the Smith Island Feasibility Report. The newsletter reported on the October meeting in Tylerton and included a form that could be mailed back to USACE with detailed information on the local resources that islanders might wish to provide. The newsletter also included information on a plan by the Md DNR to construct a small wetland restoration project at Ewell.

A newsletter dated March 2000 (Issue #3) provided a status update of the Tylerton project and an explanation of the real estate easements that might be needed. The newsletter also announced a planned visit to Tylerton on March 31 by the project team and plans for a signing ceremony to celebrate official and agency support of the Tylerton Section 510 project.

On April 24, 2000, Senator Paul S. Sarbanes and other dignitaries met with representatives of USACE, Md DNR, MDE, Somerset County, USFWS, the CBF and local residents to sign a cost sharing agreement for the Tylerton project. An official signing ceremony with several guest speakers was held at the water's edge and a celebratory lunch served in the Tylerton church. The speakers at the ceremony all spoke of the importance of implementing the other projects under consideration.

Issue #4 of the newsletter was mailed in July 2000. The newsletter reported on the status of the Smith Island Feasibility Study, which deals with plans on the entire island, and on the Tylerton project. The newsletter also discussed an effort coordinated by the Corps to improve the two wastewater treatment plants on the island and an effort by the Maryland Rural Community Assistance Project to improve solid waste management in the three Smith Island communities. A community meeting to be held on August 15, 2000, at Rhodes Point, and a team visit to Tylerton to discuss clean-up actions along the bulkhead in preparation for project construction were also announced.

The August 15, 2000, community meeting at the Rhodes Point Community Center provided an opportunity to introduce project managers from the wastewater treatment contractor and the Maryland Rural Community Assistance Project, as well as to report on the status of projects and discuss alternatives for the Rhodes Point project. Comments on the Rhodes Point alternatives resulted in ideas for modifying the project design in a way that provides improved shoreline erosion protection at Sheep Pen Gut. The Tylerton project site visit resulted in new ideas for cleaning up the project area in preparation for construction activities. Following this site visit, a notice was sent to Tylerton residents providing information about trash along the bulkhead alignment and notifying them about the dates planned for clean-up and construction work in the project areas.

Issue #5 of the newsletter announced the 90% design review meeting for the Tylerton project, to be held at the Tylerton church. The public was invited to participate in the design review and also to attend a community information meeting on the evening of November 17, 2000, to discuss the proposed design.

For more details refer to Appendix B.

Section 9

FINDINGS AND CONCLUSIONS

9.1 STUDY FINDINGS

Smith Island is Maryland's last inhabited offshore (that is, not connected by bridge) island in Chesapeake Bay. This isolation allows for unique wildlife habitat and an ecosystem that is less impacted by human activities. The northern half of the island is further protected by its designation as a National Wildlife Refuge. The Martin National Wildlife Refuge is made up of vast areas of emergent wetlands surrounded by beaches and mudflats with occasional upland hammocks that provide highly productive waterfowl nesting habitat. As with other islands in the Bay, Smith Island is eroding quickly and this invaluable habitat is being lost. As the wetland habitat erodes, the protective function of the landmasses on shallow water in the lee of the land is also lost. Further, the eroding land causes excessive suspended solids in the water column that reduces light availability at even shallow depths. The result of this erosion, beyond the loss of wetland habitat, is the loss of SAV and potential SAV habitat.

Research and literature reviews conducted as part of the Smith Island Environmental Protection and Restoration feasibility study effort lead to the conclusion that SAV habitat will be restored and protected if erosion is stopped along strategic reaches of the Smith Island shoreline. The waters surrounding Martin National Wildlife Refuge were selected as the site for the recommended projects for several reasons. First, the largest and potentially most beneficial project involves restoration of Big Thorofare, and the protective landmass that is endangered on the western shoreline of the Refuge. Second, there were historically several highly productive coves along the Refuge shoreline. Three of these were identified as candidates for restoration. Finally, the area is off-limits to most human activity and impact, and is, therefore, a prime location for restoration success.

During the reconnaissance study effort, SAV was identified as a primary benefit of the project envisioned. This study includes the results of technical investigations that were conducted with the goal of maximizing SAV protection and restoration while providing the additional benefits of wetland protection and creation, shallow-water protection, mudflat and beach protection, and other related habitat benefits.

Hydrodynamic, geotechnical and economic studies have shown that of all the habitat protection methods that could be implemented, the most effective and cost-efficient method involves constructing a series of offshore breakwaters with backfill to protect critical shoreline. The project will protect existing protective landmasses or recreate historical areas of land. The backfill behind the structures will be planted to create additional wetlands habitat. Planting is preferred over natural colonization to stabilize the new land as quickly as possible. Experience and sediment movement patterns suggest that the backfill is also necessary to ensure success of the projects. The result is SAV and wetland habitat creation and restoration on the order of a few hundred dollars per year per acre.

The biological importance of the Smith – Tangier Island area can not be overstated. Smith Island lies at the northern end of the largest contiguous SAV beds in Chesapeake Bay. The Smith Island area has continued to lose SAV while the rest of the Bay has been seen recolonization. The benefits of SAV and the importance of the area to crabs, fish and waterfowl are presented in this report.

9.2 CONCLUSIONS

Following a thorough process involving problem identification, opportunities identification, alternative plan formulation and selection, four plans have been identified as being cost-effective and of considerable environmental benefit. Two other recommendations for shoreline protection at Tylerton and navigation improvements at Rhodes Point were also identified as being in the Federal interest and are being implemented under other authorities.

The project components are all to be constructed in the waters of the State of Maryland around the shoreline of the Martin National Wildlife Refuge. As presented in this report, this project will result in tremendous benefits to SAV and wetland habitat on and around Smith Island, Maryland. The following plans comprise the recommended project of this feasibility effort:

- A series of segmented breakwaters parallel to the western shoreline of the Martin National Wildlife Refuge from Swan Island to Fog Point. The protection would be 9,840 feet long and be comprised of stone breakwaters, approximately 150 feet long, placed 30 to 100 feet offshore with gaps between the structures of varying lengths. Sand would be placed behind the structures to insure project success, and to create wetland habitat.
- Protection and restoration of Fog Point Cove by recreating and protecting landmasses at the western and eastern sides of the cove. The protection would be in the form of stone breakwaters and continuous stone sills with sand backfill to create wetland habitat and sandy shoreline to restore terrapin habitat. Further, protection of the eastern shoreline of Fog Point Cove will help to protect Back Cove from sedimentation and flanking of the northern peninsula.
- Protection of Back Cove by constructing a series of segmented breakwaters and sills along to northern protective peninsula and along the southeastern shoreline.

The total fully-funded cost for this project is $8.9 million. More detailed designs and cost estimates will be done as part of the PED phase.

9.3 VIEWS OF THE SPONSORS

As the non-Federal sponsors for the feasibility study, Md DNR, MDE and Somerset County have expressed support for the investigation throughout the reconnaissance and feasibility phases. The sponsors are aware of the items required for local cooperation, including: easements and rights-of-way, approval of the feasibility report and provision of a letter of intent, non-Federal funding requirements, and negotiation and execution of a PED agreement and a project cooperation agreement.

The sponsors have further participated throughout both the reconnaissance and feasibility studies by providing information, attending study meetings, providing technical input, and reviewing preliminary findings. The sponsors have been active in the progress of the study and have been fully supportive of the Tylerton and Rhodes Point spin-off efforts.

Section 10

RECOMMENDATIONS

Environmental problems affecting Smith Island, specifically the loss of SAV and wetlands habitat, have been carefully reviewed and potential plans of improvement have been identified and evaluated. Improvements to the western shoreline of Martin National Wildlife Refuge, Fog Point Cove and Back Cove represent a cost-effective project for reducing negative environmental impacts and increasing aquatic ecosystem restoration opportunities. These improvements will have no significant adverse impact on the quality of the environment or to the region's economic, cultural, environmental, recreational, or social uses. The project components have all been designed to maximize habitat benefits, which will have positive ramifications not only locally but also throughout the Chesapeake Bay ecosystem. Two other plans that were considered during this study effort are being implemented under separate authorities. A project to protect the town of Tylerton from erosion and tidal inundation is being implemented under Section 510 of WRDA 1996. The project has an estimated implementation cost of $2.5 million and construction is scheduled for early 2001. Navigation improvements near Rhodes Point are being considered under the continuing authority of Section 107 of the River and Harbor Act of 1960, as amended. A feasibility study is scheduled for public review in spring of 2001. Preliminary cost estimates for Rhodes Point indicate approximately $2.5 million for implementation.

Specific to the environmental restoration plans that form the recommended project of this report as listed in Section 9.2, it is anticipated that over 500 acres of SAV habitat and over 200 acres of prime emergent wetland habitat will be protected over the course of the project life. In addition, conditions will be created that are conducive to the restoration of 1400 acres of SAV and backfill will be used to create an estimated 23 acres of wetlands. This project will also protect and restore critical diamondback terrapin habitat, mudflat and shoreline habitat, and quiescent shallow-water habitat. The environmental restoration project has an estimated fully-funded cost of $8.9 million, which is to be cost-shared $5.8 million for the Federal government and $3.1 million for the non-Federal sponsors. The non-Federal sponsors shall, prior to implementation, agree to perform the required items of cooperation as detailed in this report. Such items include provision of easements and rights-of-way, approval of the feasibility report, provision of a letter of intent, non-Federal funding requirements, and negotiation of a PED agreement, and project cooperation agreement. Under current conditions the Smith Island ecosystem is under attack by the slow process of erosion. Remote island habitat and large tracts of contiguous SAV were once abundant throughout Chesapeake Bay, but have become more rare over time. This project will allow for the SAV beds around Smith Island and large unspoiled areas of emergent wetlands to be protected and restored. Impacts to environmental and cultural resources have been evaluated and are documented herein as required by the National Environmental Policy Act of 1969 and Section 106 of the National Historic Preservation Act of 1966.

As part of this study, I have given consideration to the relevant aspects of public interest, including environmental, social, economic, and engineering concerns. On the basis of this evaluation, and with the support of the project sponsors, I recommend that the U.S Army Corps of Engineers, along with the project sponsors, implement the recommended project described in the report under the Corps' Construction General Program with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable. I further recommend continued efforts to assure implementation of the Tylerton and Rhodes Point projects as described above.

The recommendations contained herein reflect information that is currently available at this time and current USACE policies governing formulation of individual projects. The recommendations do not reflect program and budgeting priorities inherent in the formulation of a National Civil Works construction program nor the perspective of higher level reviews within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the non-Federal sponsors, interested state and Federal agencies, and other parties will be advised on any modifications and will be afforded an opportunity to comment further.

Gregory E. Stinner
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

CENAD-DE (CENAB/MAY2001) (1105-2-10c) 1st End Ms. Karnish/7069
SUBJECT: Smith Island, Maryland, Environmental Restoration and Protection, Final Integrated Feasibility Report and Environmental Assessment, May 2001

Commander, North Atlantic Division, Corps of Engineers, ATTN: CENAD-ET-P, Ft. Hamilton Military Community, 301 General Lee Avenue, Brooklyn, New York 11252

FOR COMMANDER, HQUSACE ATTN: Policy Compliance Support Branch, Planning and Policy Division, 441 G Street NW, Washington DC, 20314

I generally concur with the Conclusions and Recommendations of the District Commander.

M. STEPHEN RHOADES
Brigadier General, USA
Commanding