U.S. Fish & Wildlife Service

Chesapeake Marshlands National Wildlife Refuge Complex

Comprehensive Conservation Plan

September 2006

Cover Pictures: *Premier Blackwater NWR habitat,* USFWS Photo (in background)
Delmarva Fox Squirrel, USFWS Photo
Bald Eagle, USFWS Photo
Canada Geese, USFWS Photo

This goose, designed by J.N. "Ding" Darling, has become the symbol of the National Wildlife Refuge System.

The *U.S. Fish and Wildlife Service* is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service manages the 95-million acre National Wildlife Refuge System comprised of more than 545 national wildlife refuges and thousands of waterfowl production areas. It also operates 65 national fish hatcheries and 78 ecological services field stations. The agency enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Assistance Program which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

Comprehensive Conservation Plans provide long term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Comprehensive Conservation Plan Approval
for Chesapeake Marshlands National Wildlife Refuge Complex (including: Blackwater, Martin and Susquehanna National Wildlife Refuges)

Submitted by:

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Blackwater National Wildlife Refuge

August 1, 2006
Date

Approved by:

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8/2/06
Date

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ACTING

Anthony D. Legér
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8/4/06
Date

Final Approval:

Marvin E. Moriarty
Regional Director, Region 5
U.S. Fish and Wildlife Service

Acting

8-7-06
Date

Finding of No Significant Impact
Chesapeake Marshlands National Wildlife Refuge Complex (including Blackwater, Martin, and Susquehanna National Wildlife Refuges)
Comprehensive Conservation Plan

The draft Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) of May 2005 for Chesapeake Marshlands National Wildlife Refuge (NWR) Complex (including Blackwater, Martin, and Susquehanna NWRs) evaluated three management alternatives, carefully considering their impacts on the environment, their potential contribution to the mission of the National Wildlife Refuge System (NWRS), and each refuge's purposes and goals. A brief summary of the three alternatives as presented in the draft CCP/EA follows.

Alternative A: "Current Management (No Action)." This was the No Action Alternative in the draft CCP/EA required by the Council of Environmental Quality's regulations on implementing the National Environmental Policy Act of 1969 (NEPA). Under this alternative, there would be no change from our current resource management programs on refuge lands. Chesapeake Marshlands NWR Complex would continue interpretive and environmental education programs already in place. Land acquisition would occur only within approved areas and extensions thereto as allowed by policy.

Alternative B: "Conservation Biology for Trust Species Diversity (Preferred Alternative)." This alternative was the U.S. Fish and Wildlife Service's (Service) Proposed Action in the draft CCP/EA. Land acquisition would expand to include an increase of 17,500 acres immediately surrounding the existing Blackwater NWR, and an additional 16,000 acres to be included as the Nanticoke Division of Blackwater NWR, for a total of 33,500 acres. Alternative B maintains biological diversity and environmental health, improves the resource inventory and monitoring program, and focuses on improving our ability to accommodate priority public uses. New hunting opportunities would be implemented for turkey and waterfowl.

Alternative C: "Maximum Public Use with No Habitat Management." Alternative C relies on monitoring natural processes and maximizes our management for compatible public uses on the complex. In this alternative, we narrow the emphasis and scope of our wildlife and resource management to those mandated by applicable Federal law.

The draft CCP/EA was distributed for public review from May 3 through July 15, 2005. After consideration of all public comments, I have determined that this EA was sufficient to support my findings.

After careful review of the proposed management actions, and based on the analysis provided in the EA and the comments received during the review period, I have selected Alternative B (the Service's Proposed Action in the draft CCP/EA) for implementation, with the following modifications:

Land Protection: We received a mixed response to the proposed boundary expansion. While there was a degree of support, a number of comments expressed concern about the scope of

the Land Protection Plan (LPP) and proposed boundary expansion. Some comments indicated a concern about the potential for condemnation of land by the Service.

I have revised the LPP to include protection measures other than fee-title acquisition for the Nanticoke Division of Blackwater NWR. The use of easements and management agreements, for example, is authorized for this division. Fee-title acquisition is authorized only for the boundary expansion contiguous to the existing Blackwater NWR.

Marshbird Habitat Improvement: We received comments that the CCP should recognize the distinctness and conservation value of the brackish marsh bird community and plan for its long term management.

I have added a new objective to Goal 1 to capture the significance of the brackish marsh bird community and future management strategies, including the need to adaptively manage fire in marsh ecosystems.

I have selected Alternative B for the final CCP, with the modifications noted above, because it helps fulfill the mission of the NWRS, best achieves each refuge's purpose, vision, and goals; maintains and, where appropriate, restores the ecological integrity of both refuges, addresses the significant issues identified during the planning process; and is consistent with principles of sound fish and wildlife management.

I find that the implementation of modified Alternative B will not have a significant impact on the quality of the human environment in accordance with Section 102 (2) (c) of NEPA. It adheres to all legal mandates and Service policies. As such, I have concluded that an Environmental Impact Statement is not required, and this Finding of No Significant Impact is appropriate and warranted.

Marvin E. Moriarty Acting
Regional Director
U.S. Fish and Wildlife Service
Hadley, Massachusetts

8-7-06
Date

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Chapter 1. Introduction

This chapter explains why and how we must prepare a draft Comprehensive Conservation Plan and Environmental Assessment (draft CCP and EA) for the Chesapeake Marshlands National Wildlife Refuge Complex (Refuge Complex).

- It describes the planning steps in developing this draft CCP and EA.
- It states clearly our vision for managing and protecting the lands, waters, and Federal trust resources in the Refuge Complex analysis area.
- It defines long-range refuge management goals, and highlights the legislated purpose(s) for which each refuge or division in the Refuge Complex was established.
- It describes the influences of national, regional, state, and ecosystem plans, regulations, guidelines, and laws on the scope of this draft CCP and EA.
- It also describes the issues of public concern that influenced our alternatives for managing the Refuge Complex.

Chapter 2 presents three varying management strategies for fulfilling refuge goals and objectives and addressing the issues presented in this chapter. Chapter 3 describes the affected physical, biological, and human environment. Chapter 4 evaluates the environmental consequences of implementing each of the proposed alternatives. Chapter 5 chronicles our coordination with others during the planning process.

Readers please note

For your ease of review, you may request a separate volume of condensed highlights of this CCP/EA by contacting the Refuge Complex at its address on the back cover and asking for the CCP/EA Highlights.

Volume I of this CCP/EA contains its chapters.

Volume II contains its appendixes.

Background

The U.S. Fish and Wildlife Service is part of the Department of the Interior. Our mission is

> *"working with others, to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."*

Congress has entrusted us with conserving and protecting certain national resources: national wildlife refuges, national fish hatcheries, wetlands, migratory birds, endangered species, anadromous and interjurisdictional fish, and certain marine mammals, collectively referred to as "trust species." We also enforce Federal wildlife laws and international treaties on importing and exporting wildlife, assist states with their fish and wildlife programs, and help other countries develop wildlife conservation programs.

The National Wildlife Refuge System (Refuge System) is the world's largest collection of lands and waters set aside specifically for the conservation of fish, wildlife, and plants. More than 94 million acres of land on more than 538 national wildlife refuges form that national network. Refuges in every state in the Nation provide important habitats for native plants and animals, including endangered and threatened species. More than 34 million visitors each year hunt, fish, observe and photograph wildlife, or partake in environmental education and interpretation on refuges.

The National Wildlife Refuge System Improvement Act of 1997 (NWRSIA) establishes a unifying mission for the Refuge System, a new process for determining compatible public uses on refuges, and the requirement to prepare CCPs for each refuge. The act states that, first and foremost, the Refuge System must focus on wildlife conservation. It further states that the Refuge System mission, along with the purpose(s) for which each refuge was established, will provide the principle management direction for each refuge.

The mission of the Refuge System is

> *"to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."*

Purpose and Need for Action

As part of our decision-making process, this draft CCP and EA complies with the National Environmental Policy Act (NEPA) and the NWRSIA. It presents a comprehensive environmental analysis; it develops a reasonable range of management actions grouped into varying alternatives; and, it incorporates the issues of concern the public has identified for our future management of the Refuge Complex, which comprises the following units.

- Blackwater National Wildlife Refuge (Blackwater NWR)
- The Chesapeake Island Refuges, which consist of Martin National Wildlife Refuge (Martin NWR), Eastern Neck National Wildlife Refuge (Eastern Neck NWR), Susquehanna National Wildlife Refuge (Susquehanna NWR) and its Barren Island, Watts Island, Bishops Head, and Spring Island Divisions
- Please note. Mason Neck National Wildlife Refuge formerly was a unit of the Refuge Complex, but became an independent refuge in 1973.

Our purpose is to comply with the provisions of the NWRSIA, which requires each refuge in the Refuge System to complete a CCP by 2012. The National Environmental Policy Act of 1969 (NEPA) also requires each CCP to compare a reasonable range of management alternatives, and

to evaluate the social, economic, physical, and biological impacts of each alternative on the human environment. The purposes of that process follow.

- Provide refuge neighbors, visitors, and partners with the opportunity to identify issues and concerns needed to develop meaningful management alternatives and strategies;
- Provide a clear statement of the desired future conditions for habitat, wildlife, visitor services, and facilities on refuge lands;
- Inform and educate the public and partners about the refuge environment, Service trust resources, and the types of management activities needed to protect natural resources in the study area;
- Provide a public participatory role in the establishment of refuge management goals and objectives;
- Ensure that management of the refuge reflects the policies and goals of the Refuge System;
- Identify important habitats in the study areas that refuges should help protect;
- Ensure the compatibility of future uses of each refuge;
- Provide long-term continuity and direction for refuge management; and
- Provide direction for staffing, operations, maintenance, and development of budget requests.

Before the NWRSIA, the only management plan for the Refuge Complex was its Station Management Plan (1991). However, that plan did not fully comply with NEPA. Moreover, the refuges and divisions of the Refuge Complex had only a series of topic-specific, individual management plans. Some of those followed NEPA requirements; others did not. Those individual plans were not integrated into a clear statement of management vision for the Refuge Complex, nor did they address the overall goals and policies of the Refuge System, as identified in the NWRSIA (1997).

A CCP provides a comprehensive framework for consistent and integrated refuge management; defines how the biological integrity, diversity, and environmental health of refuge lands will be maintained; identifies which of six priority wildlife-dependent recreational uses (wildlife observation and photography, hunting, fishing, and environmental education and interpretation) will be allowed, when compatible with refuge purpose(s) and the mission of the Refuge System; and, resolves persistent and extremely important issues affecting the physical, biological, and human environments of the future.

Decision to be Made

Using the analysis in this draft CCP and EA, our Regional Director will determine which alternative best fulfills the Service mission, the purpose(s) for which each refuge was established, and the goals identified in this document, and will select an alternative to be fully developed into a CCP for each of the refuges in the Refuge Complex. In conformance with NEPA, our Regional Director will also determine whether the selected management alternative will have significant impacts on the quality of the human environment. Significant impacts would require our additional analysis in an Environmental Impact Statement (EIS).

Please note that several recent management actions and plans (the Fire Management Plan, the Nutria Damage Reduction Pilot Program, and the Integrated Wildlife Damage Management Plan for Resident Canada Geese) have already complied with NEPA; their actions were certified as having no significant impact on the human environment. This CCP and EA will discuss individual management actions that already have their own final Environmental Assessment, but only in the context of our preferred alternative B, “Conservation Biology for Trust Species Diversity (Preferred Alternative).”

Analysis Area

We evaluated significant habitats on lands adjacent to the refuges and divisions in Dorchester, Caroline, Somerset, and Wicomico Counties, in Maryland; Sussex County, in Delaware; and Accomack County, in Virginia. State and local government agencies, conservation organizations, and the public identified the focus areas within our analysis area for their high habitat value for species of concern to the Service and others. Our analysis area covers the refuges and divisions of the Refuge Complex and the focus areas surrounding its land base (see figure 1, “Unit boundaries,” and figure 2, “Current and proposed protected lands in the Blackwater and Nanticoke watershed,” below).

Figure 1. Refuge locations

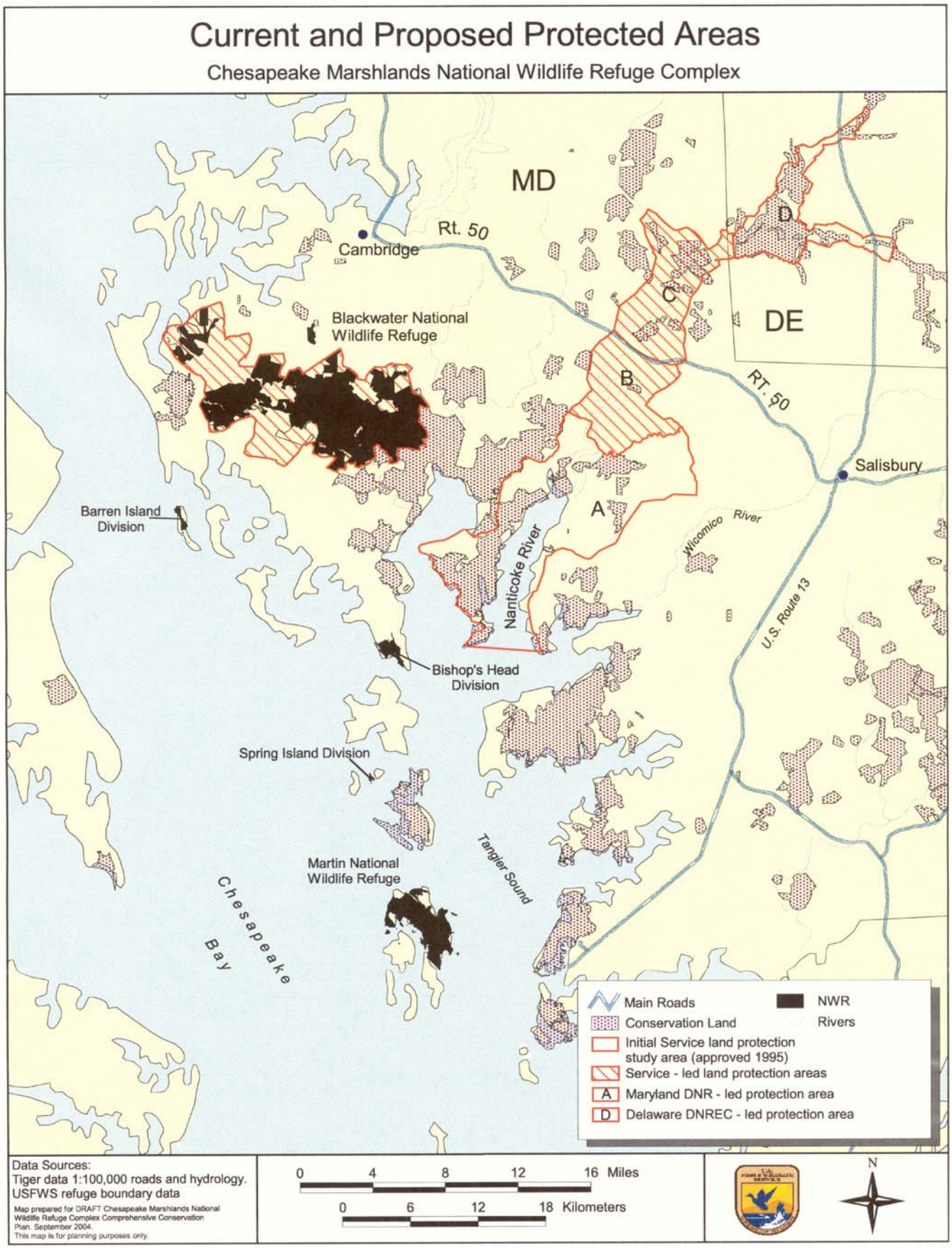

Figure 2. Current and proposed protected areas

Establishing Authorities and Refuge Purposes

Blackwater Refuge

The Migratory Bird Conservation Commission originally authorized the establishment of Blackwater NWR on December 3, 1931, as "Blackwater Migratory Bird Refuge," the first and largest of the Refuge Complex units. Its 23,444 acres are a showplace for the Refuge System. Its extensive marshes, moist-soil impoundments, and variety of croplands form the favorable trio of habitats most essential to thousands of migrating and wintering waterfowl. Its forests provide unique and important habitat for a variety of migratory birds, including bald eagles, and harbor the largest remaining population of the endangered Delmarva fox squirrel.

As well as being an outstanding waterfowl area, the refuge has a large visitor center, and offers environmental education and interpretation programs to thousands of visitors annually. Due to its diverse wildlife populations, the quality of its programs and facilities, and its proximity to Washington, D.C., the refuge regularly demonstrates Service activities to government representatives and foreign dignitaries.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from Delmarvia Fur Farms, Inc., of Philadelphia, Pennsylvania (note the original spelling of "Delmarva"). On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., to lease 8,167.99 acres for the refuge. The Secretary later determined that it was in the best interest of the Government to acquire 8,240.99 acres in fee title for the refuge from the Delmarvia Fur Farms and two other properties. Those lands were conveyed to the Government in January 1933.

Therefore, Blackwater NWR wasn't officially established under the authority of the Migratory Bird Conservation Act until January 23, 1933. Since that time, the refuge has acquired additional land under authority of the Endangered Species Act, the Refuge Recreation Act, the North American Wetlands Conservation Act, and the Refuge Administration Act. The table below summarizes that acquisition history through February 2002.

Table 1. Land acquisition history (Blackwater NWR)

Date	Tract No.	Acres	Tract Name	Authority[1]
1/13/33	18	1.00	Graveyard Tract	MBCA
1/13/33	19	72.00	Blackwater R.	MBCA
1/23/33	14,a,-I,-II,-III,b–g,i	8,167.99	Delmarvia Fur Farms	MBCA
12/01/42	16,a	355.18	Kuehnle	MBCA
8/02/45	24,a–c	2,203.21	Seward	MBCA
4/21/51	29	416.94	Smith	MBCA
6/22/72	37	408.40	Luthy	MBCA
6/23/72	38	1.15	Brooks	MBCA
6/29/72	31	1.28	Turner	MBCA
6/27/75	45,R	175.10	Spicer	ESA
5/15/78	45b–d	1,610.47	Jarrett	ESA
9/28/78	45a–e	852.84	Jarrett	ESA
10/09/84	58,-I	489.50	Handley	ESA
4/19/85	53,-I	863.00	Herman Robbins Est.	MBCA

Date	Tract No.	Acres	Tract Name	Authority[1]
4/20/64	41,R	0.00	State of MD Easement	MBCA
11/05/76	2	7.14	State of MD Exchange[2]	80 STAT. 926
3/02/77	14d	(9.89)	State of MD Exchange[3]	16 U.S.C. 668dd
8/11/87	54	71.40	Schmidt	RRA
10/21/87	55,-I	237.20	Wm. Robbins	RRA
11/02/88	99,R	445.00	Paul Handley Est.	MBCA
11/09/88	52	297.20	Rufus Robbins	MBCA
4/09/91	100	454.20	Pascal	MBCA
10/21/91	51,-I	562.70	Gregg	MBCA
12/24/91	100a–i	176.75	Barren Island	MBCA
12/30/92	101	797.78	Williams	MBCA
12/28/92	100m	459.47	Howard	RAA
12/30/92	100j	380.00	Bishops Head	RAA
12/30/92	100k	52.00	Spring Island	RAA
2/28/94	100n	856.00	Madison (Ewing)	NAWCA
8/10/94	59	201.00	Mills	MBCA
11/2/94	103	299.95	Burton	MBCA
2/7/96	100t	173.85	Elliott	MBCA
12/28/95	104a	324.34	Valiant	MBCA
5/23/96	100r	55.23	Rasche	MBCA
8/6/96	100u	1,163.06	Linthicum	MBCA
7/29/96	100p,q	431.26	Lakes	MBCA
12/16/97	100Ae	149.73	Williamson	MBCA
9/24/99	108	74.88	Spicer	MBCA
9/24/99	107r	748.26	Spicer	MBCA
7/26/99	100Af	26.50	Long	MBCA
3/29/99	105,a	174.48	LeCompte	MBCA
3/28/00	100Ag	64.73	Riggins	MBCA
6/29/72	31	1.28	Turner	MBCA
3/15/00	54a	141.60	Schmidt	MBCA
2/6/02	100Ah	109.81	Newcomb	MBCA
2/20/02	100Ai	89.25	Newcomb	MBCA
6/26/93	102	0.11	Wooten	MBCA
7/8/00	106	149.06	Stanley	MBCA
6/28/00	111	139.10	Elliott	MBCA
1/4/00	113	215.80	Lewis	MBCA

[1]MBCA: Migratory Bird Conservation Act; ESA: Endangered Species Act; RRA: Refuge Recreation Act; NAWCA: North American Wetlands Conservation Act; RAA: Refuge Administration Act
[2]Received in an exchange with the State of Maryland for land of equal value
[3]Given in an exchange with the State of Maryland for land of equal value

Purposes for Blackwater NWR.—For lands acquired under the *Migratory Bird Conservation Act* (16 U.S.C. § 715d), the purpose of the acquisition is "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

For lands acquired under the *Endangered Species Act of 1973* (16 U.S.C. § 1534), the purpose of the acquisition is "to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."

For lands acquired under the *Refuge Recreation Act* (16 U.S.C. § 460K-1), the purpose of the acquisition is for "(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; and (3) the conservation of endangered species or threatened species."

For lands acquired under the *North American Wetlands Conservation Act* (16 U.S.C. § 4401–413), the purpose of the acquisition is to "(1) protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) maintain current or improved distribution of migratory bird populations; and (3) sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the *Refuge Administration Act* (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

Susquehanna Refuge

The second refuge established was Susquehanna NWR. Long renowned for its outstanding aquatic habitat, where large numbers of diving ducks, primarily canvasback ducks, concentrated, portions of the Susquehanna Flats were closed to the "taking" of waterfowl by Presidential Order No. 2347 on August 24, 1939. President Franklin D. Roosevelt, under the authority of the Migratory Bird Treaty Act of July 3, 1918, designated a certain part of the Chesapeake Bay as the "Susquehanna Migratory Waterfowl Closed Area."

By Presidential Orders Nos. 2383 and 2529 on January 24, 1940, and December 6, 1941, respectively, President Roosevelt subsequently amended that area to further protect waterfowl and other migratory birds. On June 23, 1942, he issued Executive Order No. 9185, which declares that all waters and lands previously protected as part of the Susquehanna Migratory Waterfowl Closed Area would be reserved for use by the Department of the Interior as a "refuge and breeding ground for migratory birds and other wildlife."

On June 9, 1978, the Service published in the Federal Register and in Title 50, Code of Federal Regulations, Part 32, the changes that opened the Susquehanna Migratory Waterfowl Closed Area to the hunting of migratory waterfowl in accordance with annual hunting regulations. The Director had determined that the waterfowl food source had severely deteriorated, and that the waterfowl use accordingly had declined to the extent that a closure was no longer necessary. This rule-making, therefore, rescinded Presidential Orders Nos. 2383 and 2529.

The U.S. Coast Guard has maintained a lighthouse on Battery Island since the 1920s. Executive Order No. 9185 details that 45' X 45' reservation for the lighthouse and keeper's quarters. The newly formed Chesapeake Heritage Conservancy Battery Island Preservation Society now is trying to obtain the island through lease or transfer, so that they can properly protect and maintain its historic lighthouse keeper's quarters.

Purpose for Susquehanna NWR.—Executive Order No. 9185 establishes its purpose as "a refuge and breeding ground for migratory birds and other wildlife."

Martin Refuge

Because of his interest in wildlife conservation, the late Glenn L. Martin established Martin NWR by donating to the United States 2,482 acres of his private hunting preserve. Two deeds dated December 20, 1954, and January 11, 1955, record the donation (some later documents report 2,569.86 acres). He also undertook to find certain remaining ownerships lying north of Smiths Thorofare on the island. Unfortunately, he died before completing that task.

In May 1957, his estate offered the Government 1,377 acres at $27.06 per acre. The Migratory Bird Conservation Commission, under the authority of the Migratory Bird Treaty Act, subsequently approved the acquisition of those and other lands. That approval included our acquisition of the 0.65-acre Norman Tyler Tract (the Middleton House property) in Ewell in 1964. That brought the total refuge acreage in 1965 to 4,423 acres. A Secretarial Closing Order (1960) prohibited waterfowl hunting within a 300-yard-wide boundary of the refuge.

Purpose for Martin NWR.—For lands acquired under the *Migratory Bird Conservation Act* (16 U.S.C. 715 d), the purpose of the refuge is "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

Eastern Neck Refuge

Established by executive order on December 27, 1962, this 2,286-acre island is strategically located at the confluence of the Chester River and the Chesapeake Bay to serve resting and feeding migrating and wintering waterfowl on Maryland's Upper Eastern Shore. Its habitat includes marsh, woodland, grassland, crop land, and open water. Farming and hunting prevailed as public uses on the island, which was known as one of Maryland's best hunting areas before it became a refuge.

Today, the refuge provides habitat for more than 240 bird species, including threatened American bald eagles and transitory peregrine falcons. It hosts a large variety of migrating waterfowl and staging and overwintering tundra swans. It is also one of only four benchmark sites for the endangered Delmarva fox squirrel.

Purpose for Eastern Neck NWR.—For lands acquired under the *Migratory Bird Conservation Act* (16 U.S.C. 715 d), the purpose of the refuge is "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

Barren Island Division

The Barren Island Division, approximately 177 acres, was established on December 24, 1991 under the authority of the Migratory Bird Conservation Act. The islands are located in the Chesapeake Bay west of Hooper's Island, and serve as a major rookery for colonial bird species.

They also have been noted as the only black skimmer nesting area in the Maryland portion of the Chesapeake Bay, and a major nesting site for least terns.

Purpose for the Barren Island Division.—For lands acquired under the *Migratory Bird Conservation Act* (16 U.S.C. 715 d), the purpose of the refuge is "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

Bishops Head Division

The Bishops Head Division, comprising the 380-acre Bishops Head Tract and 52-acre Spring Island, was established on December 30, 1992, under the authority of the Migratory Bird Conservation Act. Originally the property of the famous Phillips Gunning Club, these lands protect the largest brown pelican rookery in the Chesapeake Bay, and support the cooperative management of the Chesapeake Bay Foundation Karren Noonan Environmental Education Center.

Purpose for the Bishops Head Division.—For lands acquired under the *Migratory Bird Conservation Act* (16 U.S.C. § 715d), the purpose of the refuge is "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

Watts Island Division

The Watts Island Division was established on May 2, 1995, under the authority of the Refuge Administration Act. This 125-acre jewel in the northern part of Virginia's Chesapeake Bay (Accomack County, Virginia) was acquired as a donation from The Conservation Fund with the assistance of the Richard King Mellon Foundation. Located about 15 miles southeast of Martin NWR, the island supports a least tern nesting colony, and is noted as one of the largest colonial bird rookeries in Virginia.

Purpose of the Watts Island Division.—For lands acquired under the *Refuge Administration Act* (16 U.S.C. § 668ddb), the purpose is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

Planning Process

Our planning process includes:

- A draft vision statement and goals;
- Continued collection of information on important fish and wildlife populations and habitats;

- Public involvement to identify the issues and opportunities that the plan must address;
- Analysis of a reasonable range of management alternatives based on the issues and refuge resources;
- A draft EA for public review and comment;
- A final environmental document that reflects public comment; and
- A stand-alone CCP for each refuge in the Refuge Complex, built on the alternative chosen by the Regional Director.

In compliance with NEPA and our CCP process, we began environmental analyses in April 1998, and held 17 public scoping meetings to identify relevant issues, concerns, and opportunities in Dorchester, Talbot, Caroline, Wicomico, and Somerset Counties. At those meetings, we distributed our Issues Workbooks, which describe the refuges and ask for public comments. We also mailed workbooks to more than 3,000 individuals, agencies, and organizations, and made presentations to local organizations, conservation organizations, and State representatives. Chapter 5 chronicles our public participation and outreach.

The responding public identified their issues of concern in their returned workbooks, at public meetings, and in discussions at working meetings with State and conservation organizations. Chapter 2 presents alternatives for managing those significant issues of concern, including a "no–action" alternative, which would continue species-specific management in accordance with the Station Management Plan (1991).

Following our distribution of the draft plan, we will again solicit public comments for incorporation into the final CCP. We will review the CCP periodically throughout its 15-year life span, and amend it as necessary. Any major changes to the plan would comply with NEPA, which requires renewed public notification and involvement.

The CCP is one of several plans crucial to refuge management. It provides guidance in its goals, objectives, and strategies, but may lack some of the specifics needed for implementation. We will develop step-down management plans for specific programs, as necessary, to provide more detailed direction for their day-to-day management. At the end of this chapter, we have listed the required step-down plans.

Laws and Other Directives on Managing Refuges

One major objective of our comprehensive conservation planning is to ensure that the way we manage refuges conforms with our legal mandates, the Refuge System mission, provisions of the NWRSIA, as amended, other legislation, Executive Orders, Service policy, and international treaties. For any national wildlife refuge, the purposes defined in its establishing authority (law or executive order) primarily determine its management direction, expressed in its goal statements.

Ensuring that refuge goals accurately reflect the management direction of refuge purposes and other legal authorities is important, because goals are stepped down to objectives, which are further stepped down to the strategies that we carry out on the ground. If goals do not accurately reflect the management direction spelled out by legal authorities, our on-the-ground management stemming from those goals also will not reflect that direction.

Likewise, expanding the scope of refuge goals to include issues and resources outside the purposes for which the refuge was established could, for example, result in refuge management proceeding in a direction different than that identified in the establishing authorities. In addition to reviewing these sources of legal direction during the development of refuge goals, we also considered the following laws, executive orders, and Service policy during our development of objectives, strategies, and alternatives.

Laws and Executive Orders Governing All National Wildlife Refuges

Appendix A, "Federal Mandates," summarizes some Federal laws and directives that principally govern refuge planning and management. Title 50 of the Code of Federal Regulations (50 CFR) sets forth the regulations that guide our conformance with those laws. We have highlighted some of their provisions, below.

The Refuge System Administration Act is the primary law governing the management of national wildlife refuges. One of its main provisions is that it clearly defines the conservation of fish, wildlife, and plants as the overarching mission of the Refuge System. It requires the Service to ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained. The NWRSIA amends that act.

The NWRSIA facilitates the conservation mission of the Refuge System by providing the public with opportunities to participate in compatible wildlife-dependent recreation on refuges, thereby providing for the continued use of refuges by hunters, anglers, bird watchers, and other wildlife enthusiasts. It identifies hunting, fishing, wildlife observation, photography, environmental education, and environmental interpretation as the priority public uses of refuges, when they are shown to be compatible with refuge purposes and the Refuge System mission. As previously mentioned, the NWRSIA requires that we complete comprehensive conservation plans for all refuges within a 15-year period, requires that refuges be managed according to those plans, and requires public involvement in developing those plans.

Although the NWRSIA encourages wildlife-dependent recreation on refuges, and highlights the benefits that this has to the conservation mission of the Refuge System, it also recognizes that recreational uses on refuges, if not properly managed, can detract from that mission. The act requires that all uses, including wildlife-dependent recreational uses, must be shown to be compatible with refuge purposes and the Refuge System mission before they can be allowed on a refuge. Compatibility determinations are to be based on sound professional judgment, which means determinations must be consistent with sound scientific principles of fish and wildlife management, available science and resources, and applicable laws.

Service Policy

Service policy on every aspect of managing the National Wildlife Refuge System conforms to applicable laws, executive orders, and departmental policy, but is published in greater detail than in those authorities in the Fish and Wildlife Service Manual. Because it addresses all aspects of refuge management, we do not provide a comprehensive overview here.

Service policy (602 FW 1.4.M) uses the goals of the Refuge System as a guide in developing individual refuge goals. All refuge goals must support Refuge System goals. Ours are:

- To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered;
- To perpetuate the migratory bird resource;
- To preserve a natural diversity and abundance of fauna and flora on refuge lands; and
- To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established.

International Treaties and Other Conservation Initiatives

The initiatives listed below call for the establishment of reserves, sanctuaries, preserves, and other protected areas for the protection, conservation, and management of migratory birds and their habitat, wetland-dependent birds and wetland habitat, biological diversity, species threatened with extinction, other plants and animals otherwise of national significance, and natural areas and ecosystems.

Appendix B, “International Treaties and Other Conservation Initiatives,” includes the following international treaties, agreements, and initiatives that significantly affect management actions and the development of management alternatives.

- The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
- North American Waterfowl Management Plan
- Atlantic Coast Joint Venture
- Partners In Flight
- North American Colonial Water Bird Plan
- U.S. Shorebird Conservation Plan

A common theme running through those initiatives, with respect to managing areas set aside for the protection of fish and wildlife, is to restore and protect natural habitats and ecosystems. International treaties stress protecting habitats from pollution and detrimental alteration, controlling undesirable invasive species that can threaten ecosystems, and restoring degraded ecosystems. Another common theme is to manage public uses in a way that sustains the resources being used (see appendix B).

Other Service, State, and Local Plans and Programs

The following plans and programs establish important goals, objectives, and partnership programs that also guide our development of management alternatives (see appendix C, "Other Service, State, and Local Plans and Programs" for details).

- Partners for Wildlife
- North American Wetland Conservation Act
- Region 5 Ecosystem Management Strategy
- Chesapeake Bay/Susquehanna Ecosystem Plan
- Station Management Plan for Blackwater and Martin Refuges (1991), which formed the basis for alternative A, "Species-specific Management"
- Delmarva Fox Squirrel Recovery Plan
- Habitat Conservation Plan for Delmarva Fox Squirrel
- Northeast Beach Tiger Beetle Recovery Plan
- Bald Eagle Recovery Plan
- Peregrine Falcon Recovery Plan
- Partners In Flight Mid-Atlantic Coastal Plain Bird Conservation Plan
- Regional Wetlands Conservation Plan
- Management Plan for Canada Geese in Maryland
- Chesapeake Bay Waterfowl Policy and Management Plan
- The Shorebird Conservation Network

- Partners in Flight Neotropical Migratory Bird Conservation Program
- Federal Neotropical Migratory Bird Conservation Plan
- North American Colonial Water Bird Conservation Plan
- Regional Nongame Species of Management Concern
- NAWCA Priority Waterfowl Species
- Candidate Species Conservation Plans
- State Species Conservation Plans

Most Important Laws, Regulations, Directives, and Program Incentives Affecting Refuge Management and Land Protection in the Analysis Areas

The following most important laws, regulations, directives, and program incentives significantly affect refuge management and land protection goals, objectives, and strategies in the analysis areas. For descriptions, see appendix D, "Most Important Laws, Regulations, Directives, and Program Incentives Affecting Refuge Management and Land Protection in the Analysis Areas."

Federal Programs

- Clean Water Act
- Coastal Zone Management Act of 1972 (CZMZ) and
- Coastal Zone Act Reauthorizaiton Amendment of 1990 (CZARA)
- Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)
- National Environmental Policy Act
- Endangered Species Act

The State of Maryland

- Maryland Wetland Act of 1970
- Maryland Nontidal Wetlands Protection Act of 1989
- Maryland Chesapeake Bay Critical Areas Law
- State Water Quality Certification S401
- Maryland State Programmatic General Permit

Department of Agriculture Farm Programs

- Federal Agriculture Improvement and Reform Act
- Environmental Quality Incentive Program
- Wetlands Reserve Program
- Wildlife Habitat Incentives Program
- Farmland Protection Program
- Conservation Reserve Program
- Flood Risk Reduction Program
- Emergency Watershed Protection Program

Federal and State Forestry Programs

- U.S. Forest Service Forest Stewardship Program
- U.S. Forest Service Stewardship Incentive Plan
- U.S. Department of Agriculture Forestry Incentive Program
- Maryland State Forestry Program
- Maryland Woodland Incentives Program
- Maryland Buffer Incentives Program
- Maryland Nonstructural Shore Erosion Control Act

Maryland State and Local Programs

- Wildlife Habitat Improvement Program
- Maryland Greenways Program
- Rural Legacy Program

Refuge Complex Vision Statement

"The Chesapeake Marshlands National Wildlife Refuge Complex will provide the foundation for the creation of the most complete network of protected lands in our Nation's largest estuary. This assemblage of diverse island, wetland, upland, and aquatic habitats will represent all the biotic communities unique to the upper and middle Chesapeake Bay. The Refuge Complex will continue to be internationally and nationally renowned for its wetland habitats, which sustain significant populations of waterfowl and other Service trust resources. These refuges will expand their role in protecting, restoring, and managing the full range of natural processes, community types, and native plant and animals, making them anchors for biological diversity and ecosystem-level conservation locally, regionally, and within the National Wildlife Refuge System. The Refuge Complex will serve as a leader in the strategic acquisition or protection of important habitats within the watershed, and as a center to showcase the best science and technology used for wildlife conservation.

"The Refuge Complex will demonstrate the importance of the natural world to the quality of human life; the value of, and need for, fish and wildlife management; and the human role in preserving and enhancing wildlife habitat. The Refuge Complex will forge partnerships to address the natural, historical, and cultural resource issues of the region. Local communities will recognize these refuges as national treasures, and actively participate in their stewardship. The Refuge Complex will raise public awareness and understanding of the Refuge System mission by providing clean, welcoming, safe, and accessible opportunities and facilities for compatible, high-quality,

wildlife-oriented experiences. In collaboration with many partners, a wide range of innovative, stimulating, general public and environmental education programs and activities will be provided to diverse audiences.

"By accomplishing this vision, these refuges will ensure healthy fish, wildlife, and plant resources for people to enjoy today and an enduring legacy for generations to come."

Refuge Complex Goals

The following broad goals of the Refuge Complex support the mission of the Refuge System, the purposes for which its refuges were established, and other guiding laws and plans. Along with the vision statement for the Refuge Complex, they establish management direction. They aid in selecting the proposed action alternative and developing the final CCP.

When we create and adopt the final CCP, each goal will be supported by measurable, achievable objectives and the specific strategies and tasks needed to accomplish them. We intend to accomplish these goals in a 10- to 15-year time frame. The availability of funding may affect their actual implementation.

Goal 1. Protect and enhance Service trust resources and other species and habitats of special concern.

Goal 2. Maintain a healthy and diverse ecosystem with a full range of natural processes, natural community types, and the full spectrum of native plants and animals to pass on to future generations of Americans.

Goal 3. In collaboration with our conservation partners, create the most complete network of protected lands within the Chesapeake Bay Watershed.

Goal 4. Develop and implement quality scientific research, environmental education, and wildlife recreation programs that raise public awareness and are compatible with refuge purposes.

Goal 5. Ensure that staffing, facilities, resource protection, and infrastructure are developed commensurate with plan implementation.

Public Involvement and Issues

The four major issues that follow identify public concerns about the potential effects that may arise from implementing the alternative our Regional Director selects from this CCP. We considered these issues most carefully in developing our alternatives and evaluating their environmental impacts. During the scoping process, the public identified these four major issues:

1. Potential effects of an expanding human population and changing demographics on Service trust resources;

2. Potential effects of land acquisition and refuge expansion;

3. Potential effects of habitat changes; and

4. Potential effects on floral and faunal populations.

Issue 1. Potential effects of expanding human population and changing demographics

Urban or Residential Sprawl (including some discussion of external land use changes)

About 60 percent of the Nation's population lives within a day's drive of the Refuge Complex. Because most Americans want to live, work, and play near scenic coastal areas, human populations within the analysis area and the Chesapeake Bay watershed are rapidly increasing. By 2020, the population within the watershed is expected to increase almost 33 percent (Maryland Office of Planning 2000).

The influx of humans causes substantial changes in land use. In 25 years, more than 3,500 square miles of forest, wetlands, and farms—an area 50 times greater than Washington, D.C.—will have been converted to suburban or urban uses (Chesapeake Bay Foundation 2000). The available open space is declining (e.g., farms, fields, forests, wetlands and other wildlife habitats), and the areas that remain are becoming more and more fragmented.

At the same time, land use ownership patterns are changing, as a generational shift occurs. Economic and cultural stresses are acting to replace a landscape dominated by communities of watermen, farmers, and forest owners grounded in a rural economy, with a landscape of vacation homes, retirement communities, and waterfront estates grounded in a suburban economy. Lands within the Nanticoke protection area particularly are under intense development pressure, since easily developable waterfront property is the rarest commodity in the present-day Eastern Shore real estate market.

Population growth, fragmentation, and other land use changes must serve as an important backdrop for the Refuge Complex CCP, since these forces ultimately result in elemental changes to fish, wildlife, and plant populations and to ecosystem processes. They affect land acquisition efforts, create logistical problems in land management, maintenance, and law enforcement, and produce significant recreational demands and pressures on the Refuge Complex. The salient issues in this context are

- What role should the Refuge Complex (and each refuge) play as part of the emerging larger system of interconnected protected lands within the watershed?

- What techniques can the Service employ to manage wildlife populations at viable levels in a predominantly human-altered landscape?

- What management programs can the Refuge Complex put in place that will keep the "wildlife first" mission intact and promote ecosystem integrity, while simultaneously responding to demands for public recreation and wildlife-dependent use?

Vessel Traffic

Specific concerns that surfaced under this overriding issue were the concern about increasing recreational and commercial vessel traffic within the Nanticoke protection area, the increasing demands for water-dependent recreation at Blackwater NWR, and the increasing commercial crabbing and netting in and around Martin NWR. The recent (1999) attempts at Blackwater NWR to regulate boat traffic into areas along the Blackwater River (once marsh but now open water) to minimize trespass and address human disturbances to wildlife is but one example illustrating the complex relationship between changing population demographics and increasing human use of areas previously unused.

Similarly, a recent boating study indicated that the boating public's knowledge of the special resources of the Nanticoke River is increasing. Indeed, the high quality boating environment of the river is attracting more and more boaters (Nanticoke Watershed Alliance 1996). As the demands for access points (e.g., boat ramps and marinas) increase, so will resource management challenges. Martin NWR has its own suite of unique management problems, including weekend camping on colonial water bird nesting areas, the placing of crab pots and nets so as to interfere with refuge management operations, and the increasing public demand for ecotourism businesses that want access to closed areas.

Changing Public Use Attitudes, Needs, and Demands

When Blackwater NWR was first established as a refuge for migratory birds, especially wintering waterfowl, hunting and fishing were the primary means of providing food for the table as well as the most popular forms of local recreation. Most of the area was rural, and most of the public hunted on their own land. Private landowners also allowed others to hunt their property. But, since the refuge was considered an inviolate sanctuary for wildlife and hunting was prohibited, few visitors initially came to the refuge.

After World War II, travelers on the back roads of America began to discover the refuge. As they became more informed, their perception of its role changed from only a showcase for wildlife to special places for families to visit. Volunteers soon wanted to protect our declining wetlands and wilderness, and organizations formed to partner in achieving the refuge mission. Visitation increased, and those new visitors wanted to use the refuge for many forms of recreation. Schools began to bring students to see wildlife. A recreational area, wildlife drive, and visitor center were built to meet the new demand for interpretation, wildlife observation, and environmental education. Attitudes changed as people wanted to be part of, see, and enjoy their legacy, and pass it on to a new generation.

During our several open houses, the public expressed a desire to see additional facilities and more opportunities for public use. They wanted to see a new observation tower constructed to

replace the unsafe one. They wanted to see video and observation sites, boardwalks over the marsh, canoe and kayak trails, and photo blinds.

The public indicated its desire for increased environmental education programs and teacher workshops on protecting wildlife, wildlife habitat, and our environment, especially for the children, our future. The only existing education programs for the public are three special events that have been very well attended. With funding and assistance from the Friends of Blackwater, an environmental education manual is being developed to meet the needs of the school systems. The schools have shown great enthusiasm in helping to develop the manual. However, funding is still needed to staff and carry out the program once the manual has been completed.

With only one full-time public use refuge employee on the entire Refuge Complex for the last 9 years, it often has been difficult to provide staff for interpretive and educational programs. A staff of 100 volunteers enables the Visitor Center at Blackwater to remain open, but refuge staff must fill in when volunteers are unable to work. There is an overwhelming program backlog, and requests are increasing. The Visitor Center and exhibits are outdated and need refurbishing. The public expressed a desire for more guided tours, interpretive events, interpretive programs (especially children's programs), interpretive signs and identification plaques, trail markers, maps, information leaflets, interpretive exhibits, and a new Visitor Center.

Issue 2. Potential effects of refuge expansion and land acquisition

The importance of the analysis areas' unique natural resources has been recognized internationally, nationally, regionally, and locally. Many studies have recommended protecting and managing the areas' important wetland and wildlife habitats, which support large concentrations of Federal- and State-listed rare, threatened, and endangered plant and animal species; unique ecological communities; significant concentrations of waterfowl, wading birds, shorebirds, and other migratory birds; shellfish and finfish; and resident wildlife.

Many Federal and state plans have specifically identified the analysis areas' extensive wetland habitats; they are listed as priorities for protection by the Emergency Wetlands Resources Act of 1986, the North American Waterfowl Management Plan, the Conference on Wetlands of International Importance, and several Endangered Species Recovery Plans. Our Land Acquisition Priority System, a nationwide evaluation procedure based on biological values, ranked the importance of these habitats for protecting Service trust resources as 10th in the Nation. Some of the public surveyed particularly pointed out that additional information on floral and faunal distribution, species conservation status, and land cover would help focus our acquisition priorities, and ensure that the parcels most important to Federal trust resources and the goals and objectives of the Refuge Complex were protected.

Conservation partners and members of the public who attended our scoping meetings or responded to our questionnaires also expressed their desire that the Service view land protection in a regional or landscape context. The land protection issues that surfaced focused on the need to identify (1) what should be protected, (2) the threats to trust resources, (3) landowner

preferences, and (4) the most appropriate protection methods (e.g., fee-title purchase, exchanges, conservation easements or partial rights to specific properties, leases, donations, life estates, memorandums of understanding, cooperative agreements, land regulations that prohibit or encourage certain uses, etc.).

During the scoping meetings, conservation partners voiced strong support for Service involvement in cooperatively identifying land protection priorities, and favored Service protection of lands and easements, where appropriate. Protecting additional lands and conservation easements in the vicinity of existing refuge properties and along the Nanticoke River was considered to be extremely important in fulfilling the Refuge Complex goals for endangered species, waterfowl and other migratory birds, fisheries, providing compatible recreational and educational opportunities, and ensuring public access for the future.

Many local citizens also supported additional land protection and refuge expansion. They envisioned improvements in the local economy through increased ecotourism, better protection and management of the natural resources that support their livelihoods, like commercial hunting and fishing on surrounding lands and waters, improved recreational opportunities, and improved land values. A few expressed the positive benefits of land protection and refuge expansion for achieving delisting or down-listing of endangered species, and the benefit of not having to be concerned about developing habitat conservation plans to avoid being cited for “take.”

Others, however, voiced their concerns about the potential for negative economic impacts, such as the loss of revenues that would result from the removal of land from the tax base and from forestry and agricultural production; additional regulations and restrictions being imposed on them because of refuge expansion; the potential for the expansion of endangered species’ ranges and landowner responsibilities for complying with the Endangered Species Act.

People who expressed a concern that Federal land acquisition would effectively reduce local property tax revenues believed this would place an additional financial burden on county residents who own land and pay property taxes. They were also concerned that some of our partners who don’t pay taxes, such as the State and some land trusts, might acquire additional lands as part of our comprehensive and collaborative protection of land. Others pointed out that, while the Service doesn’t pay property taxes, it does pay taxing authorities a revenue sharing payment, which, in many cases, is more per acre than the private property tax assessment.

Each year, the Service pays the taxing authorities where it owns land a revenue sharing payment, calculated as three-quarters of 1 percent of the appraised value of that land, 25 percent of the gross receipts received from the sale of refuge products, or 75¢ per acre of land held in fee title, whichever yields the greatest amount. Each year, Congress allocates, or funds, a high percentage of that amount. Land that has been removed from local tax rolls by being incorporated into a national wildlife refuge generates this payment for the taxing authority in perpetuity, yet never costs that locality anything for school or other municipal services, as would residential land development.

Comment 2. Refuge revenue sharing (presized for columns)

Several people commented about our Environmental Impact Statement (1983) to establish a specific refuge boundary for Blackwater NWR, and voiced opposition for a similar process that would identify specific parcels for fee-title acquisition. The public heatedly opposed the establishment of a formal refuge boundary in 1983, because they felt it foreshadowed their having to sell their property to the Service, thus adversely affecting land values and private sales to individuals or other entities. Because of those concerns, the Service discontinued development of its 1983 draft EIS, and reinforced its long-standing history of dealing only with willing sellers as they approached the refuge, collectively or individually. However, most people who were familiar with the 1983 draft commented that they were pleased with the focus area concept we presented during our scoping meetings.

Like all Federal agencies, the Service has the power of eminent domain, which allows condemnation as a means to acquire lands for the public good. A few landowners, particularly those from adjoining counties who had no experience with our land acquisition program, feared that the Service might condemn and take their lands without their consent. They also feared that if this happened, they would not be adequately compensated for the real value of their land. See appendix J, “Land Protection Plan,” for a detailed discussion of Service land acquisition.

Under its long-standing policy, the Service buys land only from willing sellers. Each year, a long list of landowners wishes to sell more land to the Service than we have money to buy. In a few situations, and only at the request of a landowner, the Service may use eminent domain in “friendly” condemnations, when an owner wants to sell but cannot establish a price, or when multiple owners require a settlement, or to clear title. In all cases, the price the Service pays is based on the land’s approved appraised fair market value.

Comment 3. Willing seller policy (presized for columns)

Issue 3. Potential effects of habitat changes

Wetland Loss

Since its establishment in 1933, Blackwater NWR has lost nearly 7,000 acres of wetlands. That loss has occurred primarily in the brackish tidal three-square bulrush marsh at the heart of the refuge, near the confluence of the Little Blackwater and Blackwater Rivers, but now it is also progressing downstream. Since the 1970s, several scientific studies have focused on this unusually high rate of wetland loss, which may be the result of several confounding factors, including sea-level rise, land subsidence, saltwater intrusion, severely modified hydrology, and excessive herbivory.

The Refuge Complex is located on the Eastern Shore of the Chesapeake Bay, on a low-lying terrace of the Delmarva mainland in an area of extremely low elevation and relief. The ongoing rate of sea-level rise in this area has been 3.0 mm/year, approximately twice the average worldwide rate (1.5–1.8 mm/year). Departures of this magnitude from the norm are common along much of the mid-Atlantic coast, and apparently can be attributed to crustal subsidence related to isostatic adjustment. Less conservative estimates of the rates of sea-level rise in this area, after adjusting for the relatively high rates of land subsidence in southern Dorchester County, have been as high as 65 cm over the next 100 years.

Rising water levels and storm-induced high tides in recent years have interacted to increase localized saltwater intrusion. This phenomenon has been most dramatized by patches of Loblolly pine forest dying off along the marsh–upland ecotone after saltwater intrusion. An enlarging breach in the Parson's Creek canal, which connects to the relatively high-saline Slaughter Creek and Little Choptank River, also has caused saltwater intrusion into the formerly freshwater upper reaches of the Blackwater River. On the other end of the Blackwater River, Maple Dam Road may also be affecting tidal sheet flow severely to and from the high-saline Fishing Bay. Since the turn of the 20th century, the log pilings that serve as the foundation for that road in effect have also served as a levee that has forced tidal flow under the bridge at Shorter's Wharf.

As well as those large-scale and local changes in hydrology and geomorphology, Blackwater NWR has had a continuing problem with excessive grazing by native and introduced herbivores. Indigenous muskrats were considered problematic to marsh health early in the refuge's history. Increasing populations of migratory Canada geese have caused localized marsh eat-outs in more recent decades. Most recently, increasing populations of resident Canada geese and introduced nutria have severely damaged vegetation in both moist soil impoundments and the tidal marsh on Blackwater NWR. The negative impact of nutria on marsh health is even more dramatic, because of their tendency to dig into the marshes' organic mat, effectively lowering marsh elevation to below the water line, thus precluding the germination of some floral species.

Clearly, marsh loss of this magnitude is a concern for Blackwater NWR, not only because of the substantial loss of wetland acres, but also because it compromises the ability of the refuge to fulfill its mandate to provide habitats for waterfowl and threatened or endangered species. Although the issue is very real, the solutions are not as apparent, because we lack full under-

standing of how these factors, many of which are external to the refuge, interact. Finding a set of long-term solutions to this problem also demands a response to the overriding concern of how saline we should permit the estuarine system to become.

Blackwater NWR could choose to curb or even reverse marsh loss by implementing or continuing to implement practices such as nutria control, prescribed burns, erosion control, the use of dredge spoil to raise marsh elevation, shoreline protection, and other marsh restoration techniques. On the other hand, given that sea water may have inundated most existing refuge lands by the start of the next century, another approach to solving this problem may be to work with, rather than against, those geomorphological processes. That approach may call for protecting the shoreline of uplands, improving the drainage of marshlands to flush flocculent material, and enhancing deep water habitats by stabilizing their bottoms and promoting the establishment of submerged aquatic vegetation beds (SAV).

Island Loss

Past studies have shown that the Chesapeake Bay shoreline is severely eroding in many areas (USACOE 1986, VIMS 1977, Singewald 1946). Particularly hard hit are the islands off the Eastern Shore. Since colonial times, at least 4,375 hectares have been lost in only the middle eastern portion of the Bay. The shoreline recession rates of many islands exceed 3 meters per year, with an associated load of approximately 2,541,717 kg (2,500 tons) of sediment per mile annually entering the Bay (Offshore and Coastal Technologies 1991). Water clarity and SAV health are being impacted, and some of the most important colonial water bird nesting areas and waterfowl wintering habitats in the region are being lost.

Sea-level rise and wave-generated erosion are of particular concern to the Refuge Complex, because its Chesapeake Island Refuges are significantly affected. Most of the offshore islands in the Tangier Sound and Dorchester County region, encompassing thousands of acres of tidal wetlands, shrub hammocks, forests, and beaches, are part of the Island Refuges.

Islands are a unique ecosystem component in the Chesapeake Bay watershed. Their isolation, lack of human disturbance, and few predators make them productive nesting sites for colonial water birds, waterfowl, the Federal-listed (threatened) bald eagle, and the Federal-listed (endangered) tiger beetle. In Maryland, with the exception of great blue heron and least tern, all heron and laird colonies occur on island sites, including terns, pelicans, and skimmers (Brinker pers. com.).

During spring and fall migrations, thousands of songbirds and butterflies rely on these important resting habitats. The shallow waters on their leeward side support the most expansive and productive aquatic vegetation beds in the tidal portion of the watershed. Trust resources that rely on that aquatic habitat type include migratory birds and anadromous fish. Without the wave-dampening effect of the islands, these SAV beds will be lost, as will the commercial crab fishery and local economy that depend upon them.

The issue of island loss raises the question of combating those erosion processes, or planning for their predictable environmental consequences. Unlike coastal barrier island geomorphology (sand

islands that migrate and reposition), Chesapeake Island's parent material is a hard, laminar mud clay that erodes into the water column. This eroded material generally does not accrete along other shorelines, but is deposited subaqueously in deeper Bay waters. Bay islands form over hundreds of years, as Eastern Shore peninsulas are breached and the remaining disconnected lands erode toward their center.

Due to human settlement and armoring of mainland shorelines to prevent erosion, with few exceptions new islands are not being formed. At present erosion rates, most Chesapeake Bay islands will disappear within the next 100 years. So, too, will the last remaining island community in Maryland: Smith Island, the location of Martin NWR.

Water Quality Degradation

Animal feed operations (AFOs), particularly poultry farms, and the application of their wastes as fertilizer are known to contribute nutrients, trace metals, and estrogenic compounds to surface and ground waters of both the Blackwater and Nanticoke watersheds. The Delmarva peninsula is one of the largest commercial poultry areas in the United States, annually producing 600 million chickens valued at more than $2 billion. Hog and pig farms and, to a lesser extent, dairy farms also are present in this heavily agricultural area. The amount of manure produced is staggering; e.g., 1000 chickens produce 1 ton of manure. Excessive nutrient loading from leachate and runoff from fields on which the manure is applied can contribute significantly to algal blooms, decreased water clarity, anoxia, and reduced SAV beds.

According to data from the Maryland DNR, nitrogen levels in the Nanticoke River are among the worst of all tidal tributary areas in Maryland. Similarly, the State of Delaware attributed water quality problems in the Nanticoke River to eutrophication and bacterial contamination. Eight hundred and thirty livestock farms in the watershed produce 28.8 million pounds of nitrogen annually. Poultry alone represents 99 percent of the total nitrogen entering the watershed from animal waste each year. Eutrophication from AFOs also has been linked to outbreaks of *Pfiesteria piscicida*, a dinoflagellate that has caused fish kills on the nearby Chicomicomico River. The almost 80,000 people who live in the Nanticoke watershed, 70 percent of whom use septic systems, produce an additional 0.3 million pounds of nitrogen annually.

On Blackwater NWR, the problems associated with AFOs are far fewer. Fewer than a dozen commercial poultry operations and one large hog farm exist within the Little Blackwater River, Buttons Creek, and Transquaking River watersheds. The CBFO is conducting a study to investigate the contribution of AFOs to water quality degradation within the Blackwater watershed. Regardless of the outcome of this one study, it is apparent that monitoring at some level (and perhaps mitigation) will be required as the AFO industry expands on Delmarva.

Forest Health, Composition, Fragmentation, and Management

The forest that covered the Eastern Shore before European habitation was predominantly hardwood, although increasingly mixed with pine to the southward. Large patches of pine-dominated woods exist today, but, at least in Maryland, they are largely second-growth woods, the result of extensive clearing in historic times. In aboriginal times, the woods of the Eastern

Shore were likely oak-hickory, oak-gum, or oak-pine types, all of which still exist in second-growth form. Roundtree and Davidson use the Choptank River as the dividing line, with oak-hickory forests growing on the higher grounds north of the Choptank and oak-pine on the lower ground south of the river (Carter 2000).

At the time of European settlement, Maryland's forests are believed to have covered most of the State. It is also believed that 95 percent of the Chesapeake Bay watershed was forested at that time. Forest composition was not one expansive carpet of old growth giants; instead, it was a mosaic of forest types and successional stages. Much of the forested land acquired by the refuge is in less than desirable condition, as a result of poor forest management practices and the lack of planning for future habitat conditions. A large percentage of the forested land acquired earlier (1933–1969) was either recently cleared or in an early stage of succession (<30 years). Many people expressed concern that refuge forests were not being managed properly to maintain historical forest composition and forest health for wildlife.

Maryland's forests, which now cover 42 percent of the State, are more abundant than they were 70 years ago. Not only do we have more forest land than at the turn of the century, we also have more trees. Statewide, the average amount of wood removed is less than the amount of growth that accumulates (Miller 1998). Forests are still the dominant land cover, making up 59 percent of the land base, or 24 million of the 41 million acres in the basin.

However, the public expressed concern that, despite the sound forest management practices of most forest landowners and the forest products industry, we are currently losing forest at a rate of 100 acres per day, primarily to development. In the last 15 years alone, the Bay's forest has declined by more than 471,000 acres, equivalent to about half of the State of Delaware (Society of American Foresters 1998). Others claim that Maryland's forest land base is decreasing by an estimated 10,000 acres per year, also primarily to development. Much of the current forest loss is occurring where the forests are most needed, in urbanized areas.

Many people pointed out that the most dramatic impact to wildlife populations and their habitat is the fragmentation of the habitat that remains. Fragmentation occurs when larger, contiguous forest landscapes are broken up into smaller, more isolated tracts, typically as a result of human development in once rural areas (Bates). For years, scientists have considered forest fragmentation to be one of the greatest threats to wildlife survival worldwide (Rochelle 1998). Many bird and other wildlife species require large blocks of forest for successful breeding, or some life stage of particular species requires the specialized type of habitat more likely to be found in a large natural areas than in a small patch.

Protecting large patches of natural landscape and connecting them with green corridors can help maintain the viability of populations otherwise rendered vulnerable because of small numbers or isolation. This is the basis for the Department of Natural Resources' Green Infrastructure initiative, and is the concept behind the original efforts to protect greenways (MDNR 2000). Wildlife habitat and migration corridors are being lost, and normal ecosystem functions, such as the absorption of nutrients, recharging of water supplies, and replenishment of soils are being disturbed or destroyed. Water quality has been degraded in numerous streams and rivers.

Many of Maryland's remaining wetlands have been altered by filling, draining, constructing impoundments, grazing livestock, logging, diverting freshwater, discharging industrial waste and municipal sewage, and discharging non-point pollutants such as urban and agricultural runoff. The scattered pattern of modern development not only consumes an excessive amount of land, it fragments the landscape. As roads and development divide and isolate forested areas, interior habitat decreases, human disturbance increases, opportunistic edge species replace interior species, and populations of many animals become too small to persist (Weber and Wolf).

An important additional component of this major issue was the public concern about economic loss associated with forest conversion to development and fragmentation. The viability of both agriculture and forestry depends on the availability of not just suitable land, but also of large uninterrupted tracts. Furthermore, the public expressed concern that the failure to protect substantial amounts of land from intensive development also increases the potential threat to maintaining biological diversity and the resource base needed to support natural-resource-based recreation (MDNR 2000).

Fragmentation also changes the distribution of market and non-market benefits and costs from the landscape. As fragmentation occurs, the forest base diminishes. Expansive fragmentation can eventually lead to a loss in aesthetic values, recreation, forest base employment, and harvested wood products, and to increased pressure on infrastructure (e.g., roads and utilities) (SAF 1998).

Much of the forested land now owned by the refuge was previously managed for the production of forest products, supplying forest products to families, and many small locally owned mills as well as large regional corporations. Some refuge land was owned or managed by large-scale forest product corporations like Chesapeake Forest Products, and may have supplied forest products throughout the Nation. It was noted during the scoping meetings that, once lands had been acquired by the Service they were taken out of timber production, and no longer provided forest products, which may have helped to keep small local mills in business.

The impact of man has caused dramatic shifts in species composition and cover type. The most significant of these impacts is the unregulated draining and ditching of forested wetlands for either agriculture or the management of forest monotypes. Much of the historic forested wetlands have been cleared at least once, and most likely drained to facilitate the harvest of the most recent crop of trees or to regenerate a new stand of a more preferred species that requires drier soil and better drainage. As a result, most of the hardwood-dominated swamps have been replaced with a mix of pine and hardwoods typical of drier soils.

Another prime example is the loss or conversion of the formerly vast Atlantic white cedar swamps, once a dominant forest type along the Nanticoke River. Atlantic white cedar swamps have been identified as a globally rare and declining ecotype. The ditching and draining of these swamps for agriculture, forestry, and development has resulted in a conversion to pine-hardwood mix forest type. The public thus identified opportunities for restoring the hydrology of those areas once inhabited by Atlantic white cedar, and felt that restoration should be the highest resource management concern, from a national, state, and local perspective.

Throughout the history of Blackwater NWR, and more significantly in recent years, the lack of forest management, coupled with other endemic processes, have had significant impacts on forest health. The public was quick to point out that increased stress and decreased vigor make our forests highly susceptible to disease and insect infestations. Insects and diseases often are referred to as “the silent killers” of our forests. More trees are lost to insects and diseases each year than are harvested for wood products. In the last century, a number of epidemics of forest insects and diseases have had devastating effects on tree populations. The more familiar cases include the chestnut blight, the Dutch elm disease, the southern pine beetle, the forest tent caterpillar, and most recently, the gypsy moth.

Riparian Buffers and Corridors

Forests along streams can serve as both riparian buffers and corridors. As semi-aquatic buffers between aquatic and terrestrial systems, they take up nutrients in ground and surface flow, stabilize stream banks, shade the water and maintain its temperature, and provide food and cover for aquatic and terrestrial animals alike. Riparian forests are also natural corridors for wildlife movement and dispersal, and sustain floral and fauna assemblages that may be unique in the surrounding landscape. The absence of a forested riparian area is an indicator of aquatic and terrestrial system stress within a watershed.

In the Refuge Complex, degradation and loss of riparian buffers and corridors is an issue that pertains primarily to the Nanticoke protection area. Although large contiguous blocks of forest still exist on lands proposed for the refuge, only 40 percent of the watershed remains forested. Approximately a third of riparian forest buffers along streams in the Nanticoke River watershed are less than 100' on both sides. Riparian buffers of this width are inadequate, given the high levels of nitrogen runoff from adjacent agricultural fields.

Issue 4. Potential effects on floral and faunal populations

Injurious, Invasive, or Exotic Species

The Refuge Complex is experiencing problems with certain species of exotic, invasive, and injurious plants and animals that conflict with its management objectives. The public generally expressed the opinion that exotic species should be controlled for the benefit of native species.

Nutria, exotic rodents introduced from South America into Dorchester County in the 1940s, exacerbate the rates of marsh loss. Blackwater NWR has conducted a trapper rebate program since 1989. Control by trapping occurs for about 3 months during the State trapping season. Incidental to their other duties, refuge staff kill nutria year-round. The public expressed concern that trapping was not sufficient to control nutria, that their populations and range expansion were unchecked, that nutria will negatively impact refuge management programs, and that a proposed eradication plan has not been funded. [Please note, funding for a 3-year pilot program to evaluate eradication has since been approved.] Public hunting for nutria on the refuge was suggested as a control measure.

Mute swans, exotic birds from Eurasia that escaped into the Bay from Talbot County in 1962, have increased rapidly in numbers, to about 4,000 in 2000. Federal law does not protect them, but they are protected by State law. These birds are preventing native water birds from nesting, and are destroying SAV beds used by native waterfowl, fish, and shellfish species. In 1995, Maryland DNR asked refuge staff to assist with mute swan control, and has asked the refuge manager to serve on a citizen task force to develop management measures for mute swan and other injurious species. During scoping, the public suggested mute swan hunting on the refuge as a control measure.

The gypsy moth is an exotic insect that preys on deciduous woody species, particularly oaks, and poses a threat to hardwood species through annual defoliations. The USDA Forest Service has been cooperating with the refuge in providing gypsy moth control through aerial spraying with *B.T.*, which is specific for lepidopteran larva, or with Gypcheck, which is specific for gypsy moth larva. The public has expressed concern about the impact of gypsy moths on forest health and endangered species habitat, but also expressed concern about the impacts of the spraying on other species and their habitats.

Southern pine beetles (SPB) and their effects on loblolly pine forest habitat and associated wildlife were another concern, particularly the lack of timber management and how that could set the stage for devastating outbreaks of SPB. Through the Forest Service cooperative program, the refuge is monitored for SPB outbreaks. Although isolated cases have occurred, no control has been warranted.

The public was concerned about the interference of house sparrows, grackles, and starlings with the refuge nest box programs (particularly bluebird and wood duck boxes). Refuge staff maintain and monitor bluebird and wood duck boxes on a seasonal basis, primarily with volunteer assistance. House sparrow control is conducted in blue bird boxes; no control is conducted at wood duck boxes.

The public cited white-tailed deer as interfering with the refuge cropland program, which provides food for migratory and wintering waterfowl, and they wanted deer populations reduced through hunting. Since 1985, the refuge has conducted deer hunts to reduce crop damage on the refuge and adjoining private lands, maintain herd health, prevent habitat damage, and provide wildlife-dependent recreation.

The public is worried that resident Canada geese negatively impact refuge cropland and reduce winter food supplies for migratory waterfowl. The expanding number of resident Canada geese on the refuge, now about 4,000–5,000, has become a problem. Population control measures suggested by the public to reduce damage by resident geese included hunting. Some Dorchester County residents in the vicinity of release areas also have complained that translocated geese damage lawns by eating the grass, and foul lawns, cars, and sidewalks with droppings.

Common reed (*Phragmites australis)* is a native invasive plant species that out-competes desirable plants in the forest and marsh areas, and invades refuge moist-soil impoundments. The refuge conducts limited aerial and hand spraying with glyphosate along the edges of impoundments and forest or transition zones, but funds have not been adequate to properly

manage the problem of wildlife habitat degradation. The public, while concerned about Phragmites invasions, also voiced concern about the potential negative biological effects of chemical spray, and about the impact on bald eagle hatchlings of burning Phragmites to remove dead growth.

Purple loosestrife, an exotic plant first observed on the refuge in 1996, is a wetland invader that competes with native beneficial plants. Control on the refuge has involved digging up and burning the plants, but the area of infestation continues to expand. The public wondered what efforts would be necessary to control loosestrife invasions, and what effect chemical control might have on refuge habitat and wildlife.

Johnson grass, thistle, and saltmarsh fleabane are invasive plants the public cited as cause for concern because of their competition with desirable plants. The refuge now performs spot treatments by hand spraying with Roundup® around and in agriculture and moist-soil units. The public commented that the refuge should expand its role in protecting indigenous flora, and that it would be an ideal analysis area for long-term, large-scale investigations of methods for non-indigenous plant control and propagation of affected native plants.

At issue is how far the Refuge Complex should go in eradicating or controlling problematic species. Some species, such as Japanese honeysuckle, are exotic and may be somewhat invasive, but may not directly impact refuge management objectives. However, if certain faunal communities are identified as rare, should the refuge eradicate non-indigenous species that infringe on those communities?

Lack of Scientific Data

For decades, conservation managers and researchers have lamented the lack of scientific data about wildlife populations, their habitats, and the effect of management actions. This is particularly true today, when they are tasked with developing adaptive management programs, when habitat-specific rather than species-specific management is being emphasized, when promoting biodiversity has become an almost universal management goal, when long-term ecological monitoring is considered a critical component by the scientific community, and when the occurrence of rare species is of both public and regulatory interest. Public comment encouraged the refuge to protect land to conserve and restore unique plant communities, and to work with State agencies and NGOs to protect important habitat.

The public recommended that the Refuge Complex fill four specific information gaps by implementing:

1. A baseline inventory to determine the occurrence and spatial distribution of flora and selected fauna;

2. A long-term monitoring program to determine temporal trends in selected flora and fauna;

3. An adaptive management program to guide significant habitat and population management actions; and

4. Detailed research into habitat-species relationships. Some of the more obvious relationships for investigation are waterfowl use of refuge habitats and habitat requirements for threatened or endangered species.

Rare, Threatened, or Endangered Species

The Endangered Species Act clearly mandates that we manage for Federally listed species. The Refuge Complex has contributed significantly to the protection and recovery of the bald eagle, Delmarva fox squirrel, and peregrine falcon. The peregrine falcon was delisted in 1999. Blackwater NWR continues to be a focal point for research and management of the Delmarva fox squirrel.

New recovery initiatives will be identified as land for the proposed Nanticoke protection area is protected, as new species are listed, and as detailed inventories of the Refuge Complex are completed. The Federal-listed (threatened) swamp pink *(Helonias bullata*) occurs in Dorchester County, and likely occurs on Blackwater NWR, as well. The Maryland and Delaware Natural Heritage Programs have documented 200 species of rare, threatened, or endangered plants (G1–G5, S1–S3), and almost 70 species of rare, threatened, or endangered animals within the Blackwater and Nanticoke watersheds. Globally rare species (G3, G4, or higher) include more than 20 plants and five animal species. Three natural communities that occur in the watershed (coastal plain ponds, xeric dunes, and Atlantic white cedar swamps), are likely to be ranked as globally rare once the classification has been completed.

The initial inventory by the Natural Heritage Programs makes it clear that a complete floral and faunal inventory is certainly the first step in a more comprehensive management program for rare and listed species. With this many candidate and listed species, the likelihood of management programs' conflicting is high. For example, prescribed woodland fire may be used to enhance DFS habitat by opening the understory; however, this habitat change could also have a negative effect on the use of understory by Neotropical migrant songbirds. Conversely, protecting entire floral communities may hamper silviculture intended to enhance DFS habitat. Also, the labor and time costs of intensive recovery programs may preclude other management activities due simply to fiscal or staffing constraints.

Lastly, during the scoping process, the public expressed concern that their rights as landowners would be abrogated by legal constraints associated with threatened or endangered species. Local landowners were concerned specifically that the expansion of DFS and bald eagles from refuge to private lands would hamper timber harvesting and home building, and result in economic loss.

Waterfowl

Several issues about waterfowl management were identified. Although the clear mandate for establishing Blackwater NWR (see above) to manage for waterfowl has persisted into contemporary times, the waterfowl species of concern and their associated management practices have changed. At the time the refuge was established, waterfowl production was emphasized. Testifying before the Migratory Bird Conservation Commission in 1931 on the establishment of

the refuge, Dr. Oliver L. Austin, Jr. of the U.S. Biological Survey stated "[American] black duck and blue-winged teal breed here in more concentrated numbers than any other place I have encountered them on the Eastern Shore. I consider the area the most important waterfowl breeding area on the Atlantic coast south of Labrador."

Seventy years later, both dabbling species continue to breed on the refuge. However, due to changes in agricultural practices, reforestation of cropland, and continued loss of emergent wetland, Blackwater NWR cannot be considered a major breeding area for waterfowl. This is particularly true for blue-winged teal. Aerial surveys indicate that blue-winged teal and American black duck populations have not exceeded 800 and 2500, respectively, since 1990. Blackwater NWR is now considered more a migration stopover site for the former and a wintering ground for the latter.

Although wood ducks are still considered a National Species of Special Emphasis, Blackwater NWR has curtailed its nest box program. At one time, the refuge maintained and monitored more than 200 boxes. However, this program is being reduced to one that is more for educational outreach purposes than for actual brood production since the refuge maintains excellent and sufficient palustrine forested wetlands as natural breeding and nesting habitat.

Similarly, the role of Blackwater NWR in contributing to Atlantic Flyway populations of Canada geese, both resident and migrant, has changed as the former have increased and the latter have decreased. Ironically, migrant populations of Canada geese were considered rare during the first 5 years following the establishment of the refuge, and did not appear in any substantive numbers until 1939. By the 1960s, however, more than 100,000 geese were using the refuge. Its use by migrant Canada geese has declined since then, as Atlantic Flyway populations have waned; aerial surveys since 1990 have consistently documented fewer than 26,000 geese on the refuge. Still, the refuge supports 15 percent of Maryland's midwinter Canada goose population.

In 1979, the first Canada goose broods were documented on the refuge, heralding the incipient resident goose problem. In 1989, we estimated the resident population at 350; by 1998, it had ballooned to 5000. The completion in 2000 of the "Environmental Assessment for the Management of Conflicts Associated With Non-migratory (Resident) Canada Geese" clearly indicates a new management direction. The recent and rapid increase in the mute swan population on the Chesapeake Bay, specifically, within the Chesapeake Island Refuges, also may require similar changes in management direction.

New attention to the lesser snow goose population that winters on Blackwater NWR may be warranted. The lesser snow goose is primarily a migrant in the mid-continental and Pacific flyways. However, a relatively small proportion of the continental population migrates south in the fall to the Chesapeake Bay, Currituck Sound, and adjacent waters of the Atlantic Coast. A high proportion of this regional population is the blue phase, and many of those have routinely wintered on the refuge since 1934–35. Since 1990, more recent aerial surveys indicate that 2500–3500 lesser snow geese winter on the refuge, with counts as high as 6500 during peak migration. All the other refuges on the mid-Atlantic coastal plain support greater snow geese (*Anser c. atlantica*). Apparently, the population at the refuge is unique, from both a continental

and regional perspective, and may contribute uniquely to the genetic diversity of continental lesser snow goose populations.

Waterfowl management on the Refuge Complex has been an evolving process, and will continue to be so. As tidal wetlands continue to be lost at Blackwater NWR, it may become necessary to reevaluate our current focus on dabbling duck populations, and consider creating and enhancing habitats for diving ducks. Similarly, we may need to reassess our current cropland and moist soil management program at the refuge, as its functional role in maintaining the unique lesser snow goose population becomes clearer.

Step-down Management Plans

As their name implies, step-down management plans describe specific strategies and implementation schedules, “stepping down” from general CCP goals and objectives. The CCP identifies which step-down management plans are necessary, and provides a schedule for their completion in conformance with Fish and Wildlife Service Manual part 602, chapter 4. That process recognizes the hierarchical relationship of comprehensive conservation planning; its relationship to other plans; consistency with programmatic plans for the NWRS; its relationship to Ecosystem Approach initiatives; and the involvement of appropriate staff across many programs, including Ecological Services, Fisheries, Law Enforcement, Migratory Birds, and Refuges.

In conformance with 602 FW 4D, we have chosen to describe and evaluate all management programs that require step-down plans in sufficient detail in this document to eliminate the need for their further public involvement and NEPA compliance (see chapter 4, “Environmental Consequences”). We will formally review those step-down management plans every 5 years, using peer review recommendations (620 FW 1).

Also in conformance with 620 FW 1, we will prepare an Annual Habitat Work Plan (AHWP) each year to document habitat management actions on refuge lands the previous year, the results of those management actions and, based on those results, our recommendations for the plan year. The annual habitat work plan will include forest, water, grassland, and cropland. When prescribed fire is used as a tool to accomplish habitat management, the results relating to the habitat objectives will be in the AHWP with fire planning detailed in the Prescribed Fire Plan.

List of Step-down Management Plans

- Habitat Management (and annual prescriptions)
- Wilderness
- Exotic Species
- Trapping (furbearer management)
- Fishery Management
- Disease Prevention and Control
- Hunting

- Fishing
- Sign
- Law Enforcement
- Crowd Control
- Search and Rescue
- Priority Wildlife Dependent Recreation (other than hunting and fishing)
- Fire Management
- Occupational Safety and Health
- Pollution Control
- Compliance Requirements (RCRA—hazardous waste)
- Pesticide Use and Disposal
- Cultural Resource Management
- Inventory and Monitoring of Populations
- Occupational Safety and Health

Annual Plans

- Prescribed Fire
- Annual Habitat Work Plan (includes all water, forest, cropland, and grassland management)

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Chapter 2. The Planning Process

USFWS

We manage wetlands and impoundments to provide a food source for migratory waterfowl

The Comprehensive Conservation Planning Process

Our planning process includes

- A draft vision statement and goals
- The continued collection of information on important fish and wildlife populations and habitats
- The involvement of the public in identifying the issues and opportunities that the plan must address
- The analysis of a reasonable range of management alternatives based on those issues and refuge resources
- A draft EA for public review and comment
- A CCP that reflects public comment and the alternative chosen by our Regional Director.

In compliance with NEPA and our CCP process, we began the planning process in April 1998. The public identified issues of concern in workbooks, at public meetings and in discussions with State and conservation organizations. We held 17 public scoping meetings to identify relevant issues, concerns, and opportunities in Dorchester, Talbot, Caroline, Wicomico, and Somerset Counties. At those meetings, we distributed our Issues Workbooks, which described the refuges and requested public comment. We also mailed those workbooks to more than 3,000 individuals, agencies, and organizations, and made presentations to local organizations, conservation organizations, and State representatives.

The draft CCP/EA and Draft Land Protection Plan were distributed for public review in June 2005. We have incorporated the public comments we received on the draft CCP into this final plan, where appropriate. Appendix A presents substantive public comments and our responses. We will review the CCP periodically throughout its 15-year life span, and amend it as necessary. Any major changes would require renewed public notification and involvement.

The CCP is only one of several plans crucial for refuge management. It provides guidance in its goals, objectives, and strategies, but may lack some of the specifics needed for implementation. We will develop step-down management plans, as necessary, to provide more detailed direction for day-to-day management. We have listed those step-down plans in Chapter 5.

Public Involvement and Issues

The four major issues that follow identify public concerns about the potential effects that may arise from implementing the alternative our Regional Director has selected from the draft CCP/EA. We considered these issues most carefully in developing our alternatives and evaluating their environmental impacts. During the scoping process, the public identified these four major issues:

1. Potential effects of an expanding human population and changing demographics on Service trust resources;
2. Potential effects of land acquisition and refuge expansion;
3. Potential effects of habitat changes; and
4. Potential effects on floral and faunal populations.

Issue 1. Potential effects of expanding human population and changing demographics

Urban or Residential Sprawl (including some discussion of external land use changes)

About 60 percent of the Nation's population lives within a day's drive of the Refuge Complex. Because most Americans want to live, work, and play near scenic coastal areas, human populations within the analysis area and the Chesapeake Bay watershed are rapidly increasing. By 2020, the population within the watershed is expected to increase almost 33 percent (Maryland Office of Planning 2000).

The influx of humans causes substantial changes in land use. In 25 years, more than 3,500 square miles of forest, wetlands, and farms—an area 50 times greater than Washington, D.C.—will have been converted to suburban or urban uses (Chesapeake Bay Foundation 2000). The available open space is declining (e.g., farms, fields, forests, wetlands and other wildlife habitats), and the areas that remain are becoming more and more fragmented.

At the same time, land use ownership patterns are changing, as a generational shift occurs. Economic and cultural stresses are acting to replace a landscape dominated by communities of watermen, farmers, and forest owners grounded in a rural economy, with a landscape of vacation homes, retirement communities, and waterfront estates grounded in a suburban economy. Lands within the Nanticoke protection area particularly are under intense development pressure, since easily developable waterfront property is the rarest commodity in the present-day Eastern Shore real estate market.

Population growth, fragmentation, and other land use changes must serve as an important backdrop for the Refuge Complex CCP, since these forces ultimately result in elemental changes to fish, wildlife, and plant populations and to ecosystem processes. They affect land acquisition efforts, create logistical problems in land management, maintenance, and law enforcement, and produce significant recreational demands and pressures on the Refuge Complex. The salient issues in this context are

- What role should the Refuge Complex (and each refuge) play as part of the emerging larger system of interconnected protected lands within the watershed?
- What techniques can the Service employ to manage wildlife populations at viable levels in a predominantly human-altered landscape?
- What management programs can the Refuge Complex put in place that will keep the "wildlife first" mission intact and promote ecosystem integrity, while simultaneously responding to demands for public recreation and wildlife-dependent use?

Vessel Traffic

Specific concerns that surfaced under this overriding issue were the concern about increasing recreational and commercial vessel traffic within the Nanticoke protection area, the increasing demands for water-dependent recreation at Blackwater NWR, and the increasing commercial crabbing and netting in and around Martin NWR. The recent (1999) attempts at Blackwater NWR to regulate boat traffic into areas along the Blackwater River (once marsh but now open water) to minimize trespass and address human disturbances to wildlife is but one example illustrating the complex relationship between changing population demographics and increasing human use of areas previously unused.

Similarly, a recent boating study indicated that the boating public's knowledge of the special resources of the Nanticoke River is increasing. Indeed, the high quality boating environment of the river is attracting more and more boaters (Nanticoke Watershed Alliance 1996). As the demands for access points (e.g., boat ramps and marinas) increase, so will resource management challenges. Martin NWR has its own suite of unique management problems, including weekend camping on colonial water bird nesting areas, the placing of crab pots and nets so as to interfere with refuge management operations, and the increasing public demand for ecotourism businesses that want access to closed areas.

Changing Public Use Attitudes, Needs, and Demands

During our several open houses, the public expressed a desire to see additional facilities and more opportunities for public use. They wanted to see a new observation tower constructed to replace the unsafe one. They wanted to see video and observation sites, boardwalks over the marsh, canoe and kayak trails, and photo blinds.

The public indicated its desire for increased environmental education programs and teacher workshops on protecting wildlife, wildlife habitat, and our environment, especially for the children, our future. The only existing education programs for the public are three special events that have been very well attended. With funding and assistance from the Friends of Blackwater, an environmental education manual is being developed to meet the needs of the school systems. The schools have shown great enthusiasm in helping to develop the manual. However, funding is still needed to staff and carry out the program once the manual has been completed.

Each year, the Service pays the taxing authorities where it owns land a revenue sharing payment, calculated as three-quarters of 1 percent of the appraised value of that land, 25 percent of the gross receipts received from the sale of refuge products, or 75¢ per acre of land held in fee title, whichever yields the greatest amount. Each year, Congress allocates, or funds, a high percentage of that amount. Land that has been removed from local tax rolls by being incorporated into a national wildlife refuge generates this payment for the taxing authority in perpetuity, yet never costs that locality anything for school or other municipal services, as would residential land development.

Refuge revenue sharing

With only one full-time public use refuge employee on the entire Refuge Complex for the last 9 years, it often has been difficult to provide staff for interpretive and educational programs. A staff of 100 volunteers enables the Visitor Center at Blackwater to remain open, but refuge staff must fill in when volunteers are unable to work. There is an overwhelming program backlog, and requests are increasing. The Visitor Center and exhibits are outdated and need refurbishing. The public expressed a desire for more guided tours, interpretive events, interpretive programs (especially children's programs), interpretive signs and identification plaques, trail markers, maps, information leaflets, interpretive exhibits, and a new Visitor Center.

Issue 2. Potential effects of refuge expansion and land acquisition

The importance of the analysis areas' unique natural resources has been recognized internationally, nationally, regionally, and locally. Many studies have recommended protecting and managing the areas' important wetland and wildlife habitats, which support large concentrations of Federal- and State-listed rare, threatened, and endangered plant and animal species; unique ecological communities; significant concentrations of waterfowl, wading birds, shorebirds, and other migratory birds; shellfish and finfish; and resident wildlife.

Many Federal and state plans have specifically identified the analysis areas' extensive wetland habitats; they are listed as priorities for protection by the Emergency Wetlands Resources Act of 1986, the North American Waterfowl Management Plan, the Conference on Wetlands of International Importance, and several Endangered Species Recovery Plans. Our Land Acquisition Priority System, a nationwide evaluation procedure based on biological values, ranked the importance of these habitats for protecting Service trust resources as 10th in the Nation. Some of the public surveyed particularly pointed out that additional information on floral and faunal distribution, species conservation status, and land cover would help focus our acquisition priorities, and ensure that the parcels most important to Federal trust resources and the goals and objectives of the Refuge Complex were protected.

Conservation partners and members of the public who attended our scoping meetings or responded to our questionnaires also expressed their desire that the Service view land protection in a regional or landscape context. The land protection issues that surfaced focused on the need to identify (1) what should be protected, (2) the threats to trust resources, (3) landowner preferences, and (4) the most appropriate protection methods (e.g., fee-title purchase, exchanges, conservation easements or partial rights to specific properties, leases, donations, life estates, memorandums of understanding, cooperative agreements, land regulations that prohibit or encourage certain uses, etc.).

During the scoping meetings, conservation partners voiced strong support for Service involvement in cooperatively identifying land protection priorities, and favored Service protection of lands and easements, where appropriate. Protecting additional lands and conservation easements in the vicinity of existing refuge properties and along the Nanticoke River was considered to be extremely important in fulfilling the Refuge Complex goals for endangered species, waterfowl and other migratory birds, fisheries, providing compatible recreational and educational opportunities, and ensuring public access for the future.

Many local citizens also supported additional land protection and refuge expansion. They envisioned improvements in the local economy through increased ecotourism, better protection and management of the natural resources that support their livelihoods, like commercial hunting and fishing on surrounding lands and waters, improved recreational opportunities, and improved land values. A few expressed the positive benefits of land protection and refuge expansion for achieving delisting or down-listing of endangered species, and the benefit of not having to be concerned about developing habitat conservation plans to avoid being cited for "take."

Others, however, voiced their concerns about the potential for negative economic impacts, such as the loss of revenues that would result from the removal of land from the tax base and from forestry and agricultural production; additional regulations and restrictions being imposed on them because of refuge expansion; the potential for the expansion of endangered species' ranges and landowner responsibilities for complying with the Endangered Species Act.

People who expressed a concern that Federal land acquisition would effectively reduce local property tax revenues believed this would place an additional financial burden on county residents who own land and pay property taxes. They were also concerned that some of our partners who don't pay taxes, such as the State and some land trusts, might acquire additional lands as part of our comprehensive and collaborative protection of land. Others pointed out that, while the Service doesn't pay property taxes, it does pay taxing authorities a revenue sharing payment, which, in many cases, is more per acre than the private property tax assessment.

Under its long-standing policy, the Service buys land only from willing sellers. Each year, a long list of landowners wishes to sell more land to the Service than we have money to buy. In a few situations, and only at the request of a landowner, the Service may use eminent domain in "friendly" condemnations, when an owner wants to sell but cannot establish a price, or when multiple owners require a settlement, or to clear title. In all cases, the price the Service pays is based on the land's approved appraised fair market value.

Willing seller policy

Several people commented about our Environmental Impact Statement (1983) to establish a specific refuge boundary for Blackwater NWR, and voiced opposition for a similar process that would identify specific parcels for fee-title acquisition. The public heatedly opposed the establishment of a formal refuge boundary in 1983, because they felt it foreshadowed their having to sell their property to the Service, thus adversely affecting land values and private sales to individuals or other entities. Because of those concerns, the Service discontinued development of its 1983 draft EIS, and reinforced its long-standing history of dealing only with willing sellers as they approached the refuge, collectively or individually. However, most people who were familiar with the 1983 draft commented that they were pleased with the focus area concept we presented during our scoping meetings.

Like all Federal agencies, the Service has the power of eminent domain, which allows condemnation as a means to acquire lands for the public good. A few landowners, particularly those from adjoining counties who had no experience with our land acquisition program, feared that the Service might condemn and take their lands without their consent. They also feared that if this happened, they would not be adequately compensated for the real value of their land. See appendix B, "Land Protection Plan," for a detailed discussion of Service land acquisition.

Issue 3. Potential effects of habitat changes

Wetland Loss

Since its establishment in 1933, Blackwater NWR has lost nearly 7,000 acres of wetlands. That loss has occurred primarily in the brackish tidal three-square bulrush marsh at the heart of the refuge, near the confluence of the Little Blackwater and Blackwater Rivers, but now it is also progressing downstream. Since the 1970s, several scientific studies have focused on this unusually high rate of wetland loss, which may be the result of several confounding factors, including sea-level rise, land subsidence, saltwater intrusion, severely modified hydrology, and excessive herbivory.

The Refuge Complex is located on the Eastern Shore of the Chesapeake Bay, on a low-lying terrace of the Delmarva mainland in an area of extremely low elevation and relief. The ongoing rate of sea-level rise in this area has been 3.0 mm/year, approximately twice the average worldwide rate (1.5–1.8 mm/year). Departures of this magnitude from the norm are common along much of the mid-Atlantic coast, and apparently can be attributed to crustal subsidence related to isostatic adjustment. Less conservative estimates of the rates of sea-level rise in this area, after adjusting for the relatively high rates of land subsidence in southern Dorchester County, have been as high as 65 cm over the next 100 years.

Rising water levels and storm-induced high tides in recent years have interacted to increase localized saltwater intrusion. This phenomenon has been most dramatized by patches of Loblolly pine forest dying off along the marsh–upland ecotone after saltwater intrusion. An enlarging breach in the Parson's Creek canal, which connects to the relatively high-saline Slaughter Creek and Little Choptank River, also has caused saltwater intrusion into the formerly freshwater upper reaches of the Blackwater River. On the other end of the Blackwater River, Maple Dam Road may also be affecting tidal sheet flow severely to and from the high-saline Fishing Bay. Since the turn of the 20th century, the log pilings that serve as the foundation for that road in effect have also served as a levee that has forced tidal flow under the bridge at Shorter's Wharf.

As well as those large-scale and local changes in hydrology and geomorphology, Blackwater NWR has had a continuing problem with excessive grazing by native and introduced herbivores. Indigenous muskrats were considered problematic to marsh health early in the refuge's history. Increasing populations of migratory Canada geese have caused localized marsh eat-outs in more recent decades. Most recently, increasing populations of resident Canada geese and introduced nutria have severely damaged vegetation in both moist soil impoundments and the tidal marsh on Blackwater NWR. The negative impact of nutria on marsh health is even more dramatic, because of their tendency to dig into the marshes' organic mat, effectively lowering marsh elevation to below the water line, thus precluding the germination of some floral species.

Clearly, marsh loss of this magnitude is a concern for Blackwater NWR, not only because of the substantial loss of wetland acres, but also because it compromises the ability of the refuge to fulfill its mandate to provide habitats for waterfowl and threatened or endangered species. Although the issue is very real, the solutions are not as apparent, because we lack full understanding of how these factors, many of which are external to the refuge, interact. Finding a set of long-term solutions to this problem also demands a response to the overriding concern of how saline we should permit the estuarine system to become.

Blackwater NWR could choose to curb or even reverse marsh loss by implementing or continuing to implement practices such as nutria control, prescribed burns, erosion control, the use of dredge spoil to raise marsh elevation, shoreline protection, and other marsh restoration techniques. On the other hand, given that sea water may have inundated most existing refuge lands by the start of the next century, another approach to solving this problem may be to work with, rather than against, those geomorphological processes. That approach may call for protecting the shoreline of uplands, improving the drainage of marshlands to flush flocculent material, and enhancing deep water habitats by stabilizing their bottoms and promoting the establishment of submerged aquatic vegetation beds (SAV).

Island Loss

Past studies have shown that the Chesapeake Bay shoreline is severely eroding in many areas (USACOE 1986, VIMS 1977, Singewald 1946). Particularly hard hit are the islands off the Eastern Shore. Since colonial times, at least 4,375 hectares have been lost in only the middle eastern portion of the Bay. The shoreline recession rates of many islands exceed 3 meters per year, with an associated load of approximately 2,541,717 kg (2,500 tons) of sediment per mile annually entering the Bay (Offshore and Coastal Technologies 1991). Water clarity and SAV health are being impacted, and some of the most important colonial water bird nesting areas and waterfowl wintering habitats in the region are being lost.

Sea-level rise and wave-generated erosion are of particular concern to the Refuge Complex, because its Chesapeake Island Refuges are significantly affected. Most of the offshore islands in the Tangier Sound and Dorchester County region, encompassing thousands of acres of tidal wetlands, shrub hammocks, forests, and beaches, are part of the Island Refuges.

Islands are a unique ecosystem component in the Chesapeake Bay watershed. Their isolation, lack of human disturbance, and few predators make them productive nesting sites for colonial water birds, waterfowl, the Federal-listed (threatened) bald eagle, and the Federal-listed (endangered) tiger beetle. In Maryland, with the exception of great blue heron and least tern, all heron and laird colonies occur on island sites, including terns, pelicans, and skimmers (Brinker pers. com.).

During spring and fall migrations, thousands of songbirds and butterflies rely on these important resting habitats. The shallow waters on their leeward side support the most expansive and productive aquatic vegetation beds in the tidal portion of the watershed. Trust resources that rely on that aquatic habitat type include migratory birds and anadromous fish. Without the wave-dampening effect of the islands, these SAV beds will be lost, as will the commercial crab fishery and local economy that depend upon them.

The issue of island loss raises the question of combating those erosion processes, or planning for their predictable environmental consequences. Unlike coastal barrier island geomorphology (sand islands that migrate and reposition), Chesapeake Island's parent material is a hard, laminar mud clay that erodes into the water column. This eroded material generally does not accrete along other shorelines, but is deposited subaqueously in deeper Bay waters. Bay islands form over hundreds of years, as Eastern Shore peninsulas are breached and the remaining disconnected lands erode toward their center.

Due to human settlement and armoring of mainland shorelines to prevent erosion, with few exceptions new islands are not being formed. At present erosion rates, most Chesapeake Bay islands will disappear within the next 100 years. So, too, will the last remaining island community in Maryland, Smith Island, the location of Martin NWR.

Water Quality Degradation

Animal feed operations (AFOs), particularly poultry farms, and the application of their wastes as fertilizer are known to contribute nutrients, trace metals, and estrogenic compounds to surface and ground waters of both the Blackwater and Nanticoke watersheds. The Delmarva peninsula is one of the largest commercial poultry areas in the United States, annually producing 600 million chickens valued at more than $2 billion. Hog and pig farms and, to a lesser extent, dairy farms also are present in this heavily agricultural area. The amount of manure produced is staggering; e.g., 1000 chickens produce 1 ton of manure. Excessive nutrient loading from leachate and runoff from fields on which the manure is applied can contribute significantly to algal blooms, decreased water clarity, anoxia, and reduced SAV beds.

According to data from the Maryland DNR, nitrogen levels in the Nanticoke River are among the worst of all tidal tributary areas in Maryland. Similarly, the State of Delaware attributed water quality problems in the Nanticoke River to eutrophication and bacterial contamination. Eight hundred and thirty livestock farms in the watershed produce 28.8 million pounds of nitrogen annually. Poultry alone represents 99 percent of the total nitrogen entering the watershed from animal waste each year. Eutrophication from AFOs also has been linked to outbreaks of *Pfiesteria piscicida*, a dinoflagellate that has caused fish kills on the nearby Chicomicomico River. The almost 80,000

people who live in the Nanticoke watershed, 70 percent of whom use septic systems, produce an additional 0.3 million pounds of nitrogen annually.

On Blackwater NWR, the problems associated with AFOs are far fewer. Fewer than a dozen commercial poultry operations and one large hog farm exist within the Little Blackwater River, Buttons Creek, and Transquaking River watersheds. The CBFO is conducting a study to investigate the contribution of AFOs to water quality degradation within the Blackwater watershed. Regardless of the outcome of this one study, it is apparent that monitoring at some level (and perhaps mitigation) will be required as the AFO industry expands on Delmarva.

Forest Health, Composition, Fragmentation, and Management

The forest that covered the Eastern Shore before European habitation was predominantly hardwood, although increasingly mixed with pine to the southward. Large patches of pine-dominated woods exist today, but, at least in Maryland, they are largely second-growth woods, the result of extensive clearing in historic times. In aboriginal times, the woods of the Eastern Shore were likely oak-hickory, oak-gum, or oak-pine types, all of which still exist in second-growth form. Roundtree and Davidson use the Choptank River as the dividing line, with oak-hickory forests growing on the higher grounds north of the Choptank and oak-pine on the lower ground south of the river (Carter 2000).

At the time of European settlement, Maryland's forests are believed to have covered most of the State. It is also believed that 95 percent of the Chesapeake Bay watershed was forested at that time. Forest composition was not one expansive carpet of old growth giants; instead, it was a mosaic of forest types and successional stages. Much of the forested land acquired by the refuge is in less than desirable condition, as a result of poor forest management practices and the lack of planning for future habitat conditions. A large percentage of the forested land acquired earlier (1933–1969) was either recently cleared or in an early stage of succession (<30 years). Many people expressed concern that refuge forests were not being managed properly to maintain historical forest composition and forest health for wildlife.

Maryland's forests, which now cover 42 percent of the State, are more abundant than they were 70 years ago. Not only do we have more forest land than at the turn of the century, we also have more trees. Statewide, the average amount of wood removed is less than the amount of growth that accumulates (Miller 1998). Forests are still the dominant land cover, making up 59 percent of the land base, or 24 million of the 41 million acres in the basin.

However, the public expressed concern that, despite the sound forest management practices of most forest landowners and the forest products industry, we are currently losing forest at a rate of 100 acres per day, primarily to development. In the last 15 years alone, the Bay's forest has declined by more than 471,000 acres, equivalent to about half of the State of Delaware (Society of American Foresters 1998). Others claim that Maryland's forest land base is decreasing by an estimated 10,000 acres per year, also primarily to development. Much of the current forest loss is occurring where the forests are most needed, in urbanized areas.

Many people pointed out that the most dramatic impact to wildlife populations and their habitat is the fragmentation of the habitat that remains. Fragmentation occurs when larger, contiguous forest landscapes are broken up into smaller, more isolated tracts, typically as a result of human development in once rural areas (Bates). For years, scientists have considered forest fragmentation to be one of the greatest threats to wildlife survival worldwide (Rochelle 1998). Many birds and other wildlife species require large blocks of forest for successful breeding, or some life stage of particular species requires the specialized type of habitat more likely to be found in large natural areas than in a small patch.

Protecting large patches of natural landscape and connecting them with green corridors can help maintain the viability of populations otherwise rendered vulnerable because of small numbers or isolation. This is the basis for the Department of Natural Resources' Green Infrastructure initiative, and is the concept behind the original efforts to protect greenways (MDNR 2000). Wildlife habitat and migration corridors are being lost, and normal ecosystem functions, such as the absorption of nutrients, recharging of water supplies, and replenishment of soils are being disturbed or destroyed. Water quality has been degraded in numerous streams and rivers.

Many of Maryland's remaining wetlands have been altered by filling, draining, constructing impoundments, grazing livestock, logging, diverting freshwater, discharging industrial waste and municipal sewage, and discharging non-point pollutants such as urban and agricultural runoff. The scattered pattern of modern development not only consumes an excessive amount of land, it fragments the landscape. As roads and development divide and isolate forested areas, interior habitat decreases, human disturbance increases, opportunistic edge species replace interior species, and populations of many animals become too small to persist (Weber and Wolf).

An important additional component of this major issue was the public concern about economic loss associated with forest conversion to development and fragmentation. The viability of both agriculture and forestry depends on the availability of not just suitable land, but also of large uninterrupted tracts. Furthermore, the public expressed concern that the failure to protect substantial amounts of land from intensive development also increases the potential threat to maintaining biological diversity and the resource base needed to support natural-resource-based recreation (MDNR 2000).

Fragmentation also changes the distribution of market and non-market benefits and costs from the landscape. As fragmentation occurs, the forest base diminishes. Expansive fragmentation can eventually lead to a loss in aesthetic values, recreation, forest base employment, and harvested wood products, and to increased pressure on infrastructure (e.g., roads and utilities) (SAF 1998).

Much of the forested land now owned by the refuge was previously managed for the production of forest products, supplying forest products to families, and many small locally owned mills as well as large regional corporations. Some refuge land was owned or managed by large-scale forest product corporations like Chesapeake Forest Products, and may have supplied forest products throughout the Nation. It was noted during the scoping meetings that, once lands had been acquired by the Service they were taken out of timber production, and no longer provided forest products, which may have helped to keep small local mills in business.

The impact of man has caused dramatic shifts in species composition and cover type. The most significant of these impacts is the unregulated draining and ditching of forested wetlands for either agriculture or the management of forest monotypes. Much of the historic forested wetlands have been cleared at least once, and most likely drained to facilitate the harvest of the most recent crop of trees or to regenerate a new stand of a more preferred species that requires drier soil and better drainage. As a result, most of the hardwood-dominated swamps have been replaced with a mix of pine and hardwoods typical of drier soils.

Another prime example is the loss or conversion of the formerly vast Atlantic white cedar swamps, once a dominant forest type along the Nanticoke River. Atlantic white cedar swamps have been identified as a globally rare and declining ecotype. The ditching and draining of these swamps for agriculture, forestry, and development has resulted in a conversion to pine-hardwood mix forest type. The public thus identified opportunities for restoring the hydrology of those areas once inhabited by Atlantic white cedar, and felt that restoration should be the highest resource management concern, from a national, state, and local perspective.

Throughout the history of Blackwater NWR, and more significantly in recent years, the lack of forest management, coupled with other endemic processes, have had significant impacts on forest health. The public was quick to point out that increased stress and decreased vigor make our forests highly susceptible to disease and insect infestations. Insects and diseases often are referred to as "the silent killers" of our forests. More trees are lost to insects and diseases each year than are harvested for wood products. In the last century, a number of epidemics of forest insects and diseases have had devastating effects on tree populations. The more familiar cases include the chestnut blight, the Dutch elm disease, the southern pine beetle, the forest tent caterpillar, and most recently, the gypsy moth.

Riparian Buffers and Corridors

Forests along streams can serve as both riparian buffers and corridors. As semi-aquatic buffers between aquatic and terrestrial systems, they take up nutrients in ground and surface flow, stabilize stream banks, shade the water and maintain its temperature, and provide food and cover for aquatic and terrestrial animals alike. Riparian forests are also natural corridors for wildlife movement and dispersal, and sustain floral and fauna assemblages that may be unique in the surrounding landscape. The absence of a forested riparian area is an indicator of aquatic and terrestrial system stress within a watershed.

In the Refuge Complex, degradation and loss of riparian buffers and corridors is an issue that pertains primarily to the Nanticoke protection area. Although large contiguous blocks of forest still exist on lands proposed for the refuge, only 40 percent of the watershed remains forested. Approximately a third of riparian forest buffers along streams in the Nanticoke River watershed are less than 100' on both sides. Riparian buffers of this width are inadequate, given the high levels of nitrogen runoff from adjacent agricultural fields.

Issue 4. Potential effects on floral and faunal populations

Injurious, Invasive, or Exotic Species

The Refuge Complex is experiencing problems with certain species of exotic, invasive, and injurious plants and animals that conflict with its management objectives. The public generally expressed the opinion that exotic species should be controlled for the benefit of native species.

Nutria, exotic rodents introduced from South America into Dorchester County in the 1940s, exacerbate the rates of marsh loss. Blackwater NWR has conducted a trapper rebate program since 1989. Control by trapping occurs for about 3 months during the State trapping season. Incidental to their other duties, refuge staff kill nutria year-round. The public expressed concern that trapping was not sufficient to control nutria, that their populations and range expansion were unchecked, that nutria will negatively impact refuge management programs, and that a proposed eradication plan has not been funded. [Please note, funding for a 3-year pilot program to evaluate eradication has since been approved.] Public hunting for nutria on the refuge was suggested as a control measure.

Mute swans, exotic birds from Eurasia that escaped into the Bay from Talbot County in 1962, have increased rapidly in numbers, to about 4,000 in 2000. Federal law does not protect them, but they are protected by State law. These birds are preventing native water birds from nesting, and are destroying SAV beds used by native waterfowl, fish, and shellfish species. In 1995, Maryland DNR asked refuge staff to assist with mute swan control, and has asked the refuge manager to serve on a citizen task force to develop management measures for mute swan and other injurious species. During scoping, the public suggested mute swan hunting on the refuge as a control measure.

The gypsy moth is an exotic insect that preys on deciduous woody species, particularly oaks, and poses a threat to hardwood species through annual defoliations. The USDA Forest Service has been cooperating with the refuge in providing gypsy moth control through aerial spraying with *B.T.,* which is specific for lepidopteran larva, or with Gypcheck, which is specific for gypsy moth larva. The public has expressed concern about the impact of gypsy moths on forest health and endangered species habitat, but also expressed concern about the impacts of the spraying on other species and their habitats.

Southern pine beetles (SPB) and their effects on loblolly pine forest habitat and associated wildlife were another concern, particularly the lack of timber management and how that could set the stage for devastating outbreaks of SPB. Through the Forest Service cooperative program, the refuge is monitored for SPB outbreaks. Although isolated cases have occurred, no control has been warranted.

The public was concerned about the interference of house sparrows, grackles, and starlings with the refuge nest box programs (particularly bluebird and wood duck boxes). Refuge staff maintain and monitor bluebird and wood duck boxes on a seasonal basis, primarily with volunteer assistance. House sparrow control is conducted in blue bird boxes; no control is conducted at wood duck boxes.

The public cited white-tailed deer as interfering with the refuge cropland program, which provides food for migratory and wintering waterfowl, and they wanted deer populations reduced through hunting. Since 1985, the refuge has conducted deer hunts to reduce crop damage on the refuge and adjoining private lands, maintain herd health, prevent habitat damage, and provide wildlife-dependent recreation.

The public is worried that resident Canada geese negatively impact refuge cropland and reduce winter food supplies for migratory waterfowl. The expanding number of resident Canada geese on the refuge, now about 4,000–5,000, has become a problem. Population control measures suggested by the public to reduce damage by resident geese

included hunting. Some Dorchester County residents in the vicinity of release areas also have complained that translocated geese damage lawns by eating the grass, and foul lawns, cars, and sidewalks with droppings.

Common reed (*Phragmites australis)* is a native invasive plant species that out-competes desirable plants in the forest and marsh areas, and invades refuge moist-soil impoundments. The refuge conducts limited aerial and hand spraying with glyphosate along the edges of impoundments and forest or transition zones, but funds have not been adequate to properly manage the problem of wildlife habitat degradation. The public, while concerned about Phragmites invasions, also voiced concern about the potential negative biological effects of chemical spray, and about the impact on bald eagle hatchlings of burning Phragmites to remove dead growth.

Purple loosestrife, an exotic plant first observed on the refuge in 1996, is a wetland invader that competes with native beneficial plants. Control on the refuge has involved digging up and burning the plants, but the area of infestation continues to expand. The public wondered what efforts would be necessary to control loosestrife invasions, and what effect chemical control might have on refuge habitat and wildlife.

Johnson grass, thistle, and saltmarsh fleabane are invasive plants the public cited as cause for concern because of their competition with desirable plants. The refuge now performs spot treatments by hand spraying with Roundup® around and in agriculture and moist-soil units. The public commented that the refuge should expand its role in protecting indigenous flora, and that it would be an ideal analysis area for long-term, large-scale investigations of methods for non-indigenous plant control and propagation of affected native plants.

At issue is how far the Refuge Complex should go in eradicating or controlling problematic species. Some species, such as Japanese honeysuckle, are exotic and may be somewhat invasive, but may not directly impact refuge management objectives. However, if certain faunal communities are identified as rare, should the refuge eradicate non-indigenous species that infringe on those communities?

Lack of Scientific Data

For decades, conservation managers and researchers have lamented the lack of scientific data about wildlife populations, their habitats, and the effect of management actions. This is particularly true today, when they are tasked with developing adaptive management programs, when habitat-specific rather than species-specific management is being emphasized, when promoting biodiversity has become an almost universal management goal, when long-term ecological monitoring is considered a critical component by the scientific community, and when the occurrence of rare species is of both public and regulatory interest. Public comment encouraged the refuge to protect land to conserve and restore unique plant communities, and to work with State agencies and NGOs to protect important habitat.

The public recommended that the Refuge Complex fill four specific information gaps by implementing:

1. A baseline inventory to determine the occurrence and spatial distribution of flora and selected fauna;
2. A long-term monitoring program to determine temporal trends in selected flora and fauna;
3. An adaptive management program to guide significant habitat and population management actions; and
4. Detailed research into habitat-species relationships. Some of the more obvious relationships for investigation are waterfowl use of refuge habitats and habitat requirements for threatened or endangered species.

Rare, Threatened, or Endangered Species

The Endangered Species Act clearly mandates that we manage for Federal-listed species. The Refuge Complex has contributed significantly to the protection and recovery of the bald eagle, Delmarva fox squirrel, and peregrine falcon. The peregrine falcon was delisted in 1999. Blackwater NWR continues to be a focal point for research and management of the Delmarva fox squirrel.

New recovery initiatives will be identified as land for the proposed Nanticoke protection area is protected, as new species are listed, and as detailed inventories of the Refuge Complex are completed. The Federal-listed (threatened) swamp pink *(Helonias bullata)* occurs in Dorchester County, and likely occurs on Blackwater NWR, as well. The Maryland and Delaware Natural Heritage Programs have documented 200 species of rare, threatened, or endangered plants (G1–G5, S1–S3), and almost 70 species of rare, threatened, or endangered animals within the Blackwater and Nanticoke watersheds. Globally rare species (G3, G4, or higher) include more than 20 plants and five animal species. Three natural communities that occur in the watershed (coastal plain ponds, xeric dunes, and Atlantic white cedar swamps) are likely to be ranked as globally rare once the classification has been completed.

The initial inventory by the Natural Heritage Programs makes it clear that a complete floral and faunal inventory is certainly the first step in a more comprehensive management program for rare and listed species. With this many candidate and listed species, the likelihood of management programs' conflicting is high. For example, prescribed woodland fire may be used to enhance DFS habitat by opening the understory; however, this habitat change could also have a negative effect on the use of understory by Neotropical migrant songbirds. Conversely, protecting entire floral communities may hamper silviculture intended to enhance DFS habitat. Also, the labor and time costs of intensive recovery programs may preclude other management activities due simply to fiscal or staffing constraints.

Lastly, during the scoping process, the public expressed concern that their rights as landowners would be abrogated by legal constraints associated with threatened or endangered species. Local landowners were concerned specifically that the expansion of DFS and bald eagles from refuge to private lands would hamper timber harvesting and home building, and result in economic loss.

Waterfowl

Several issues about waterfowl management were identified. Although the clear mandate for establishing Blackwater NWR to manage for waterfowl has persisted into contemporary times, the waterfowl species of concern and their associated management practices have changed. At the time the refuge was established, waterfowl production was emphasized. Testifying before the Migratory Bird Conservation Commission in 1931 on the establishment of the refuge, Dr. Oliver L. Austin, Jr. of the U.S. Biological Survey stated "[American] black duck and blue-winged teal breed here in more concentrated numbers than any other place I have encountered them on the Eastern Shore. I consider the area the most important waterfowl breeding area on the Atlantic coast south of Labrador."

Seventy years later, both dabbling species continue to breed on the refuge. However, due to changes in agricultural practices, reforestation of cropland, and continued loss of emergent wetland, Blackwater NWR cannot be considered a major breeding area for waterfowl. This is particularly true for blue-winged teal. Aerial surveys indicate that blue-winged teal and American black duck populations have not exceeded 800 and 2500, respectively, since 1990. Blackwater NWR is now considered more a migration stopover site for the former and a wintering ground for the latter.
Although wood ducks are still considered a National Species of Special Emphasis, Blackwater NWR has curtailed its nest box program. At one time, the refuge maintained and monitored more than 200 boxes. However, this program is being reduced to one that is more for educational outreach purposes than for actual brood production since the refuge maintains excellent and sufficient palustrine forested wetlands as natural breeding and nesting habitat.

Similarly, the role of Blackwater NWR in contributing to Atlantic Flyway populations of Canada geese, both resident and migrant, has changed as the former have increased and the latter have decreased. Ironically, migrant populations of Canada geese were considered rare during the first 5 years following the establishment of the refuge,

and did not appear in any substantive numbers until 1939. By the 1960s, however, more than 100,000 geese were using the refuge. Its use by migrant Canada geese has declined since then, as Atlantic Flyway populations have waned; aerial surveys since 1990 have consistently documented fewer than 26,000 geese on the refuge. Still, the refuge supports 15 percent of Maryland's midwinter Canada goose population.

In 1979, the first Canada goose broods were documented on the refuge, heralding the incipient resident goose problem. In 1989, we estimated the resident population at 350; by 1998, it had ballooned to 5000. The completion in 2000 of the "Environmental Assessment for the Management of Conflicts Associated with Non-migratory (Resident) Canada Geese" clearly indicates a new management direction. The recent and rapid increase in the mute swan population on the Chesapeake Bay, specifically, within the Chesapeake Island Refuges, also may require similar changes in management direction.

New attention to the lesser snow goose population that winters on Blackwater NWR may be warranted. The lesser snow goose is primarily a migrant in the mid-continental and Pacific flyways. However, a relatively small proportion of the continental population migrates south in the fall to the Chesapeake Bay, Currituck Sound, and adjacent waters of the Atlantic Coast. A high proportion of this regional population is the blue phase, and many of those have routinely wintered on the refuge since 1934–35. Since 1990, more recent aerial surveys indicate that 2500–3500 lesser snow geese winter on the refuge, with counts as high as 6500 during peak migration. All the other refuges on the mid-Atlantic coastal plain support greater snow geese (*Anser c. atlantica*). Apparently, the population at the refuge is unique, from both a continental and regional perspective, and may contribute uniquely to the genetic diversity of continental lesser snow goose populations.

Waterfowl management on the Refuge Complex has been an evolving process, and will continue to be so. As tidal wetlands continue to be lost at Blackwater NWR, it may become necessary to reevaluate our current focus on dabbling duck populations, and consider creating and enhancing habitats for diving ducks. Similarly, we may need to reassess our current cropland and moist soil management program at the refuge, as its functional role in maintaining the unique lesser snow goose population becomes clearer.

Chapter 3. Refuge and Resource Descriptions

USFWS

Egrets and other wading birds utilize the impoundments during the drawdown season

Refuge and Resource Descriptions

This chapter describes the natural and human environment of the Chesapeake Bay ecosystem, the Refuge Complex, and our Environmental Assessment study area. The biological diversity, biotic integrity, and environmental health of these lands are crucial in planning the future management of the Refuge Complex under the provisions of the RSIA and other laws.

The Refuge Complex is internationally and nationally important in several ways. Most notably, it provides important migration, breeding, and wintering habitat for migratory birds, including waterfowl, shorebirds, marsh and water birds, raptors, and Neotropical migratory birds in the Western Hemisphere. One illustration of its importance is its designation in 1987 as a "Wetland Of International Importance," under the Convention on Wetlands (Ramsar, Iran 1971). The Refuge Complex is one of only 18 such sites in the United States to have received that designation.

The Refuge Complex wetlands are also an Atlantic Coast Joint Venture focus area, one of six priority areas identified in the North American Waterfowl Management Plan (NAWMP), which established a cooperative effort between the United States, Canada, and Mexico to reverse declines in waterfowl populations and protect and enhance their habitats. The Service is also a partner in the international Partners in Flight program, a voluntary collaboration of governmental and private organizations in North, Central, and South America. Blackwater and Martin NWRs were designated as Internationally Important Bird Areas in March 1997 by the American Bird Conservancy to bring recognition to places significant to the conservation of birds.

Figure 3.1. The mid-Atlantic coast of the United States and Chesapeake Bay (Ellison and Nichols 1975)

Regional Context

The Refuge Complex is situated in the Mid-Atlantic Coastal Plain Physiographic Area, and in the heart of the Region 5 Chesapeake Bay/Susquehanna River Ecosystem, on Maryland's famous Eastern Shore. The Chesapeake Bay, North America's largest and most biologically diverse estuary, is home to more than 3,600 species of plants, fish, and animals. For more than 300 years, the Bay and its tributaries have sustained the region's economy and defined its traditions and culture. It is a resource of extraordinary productivity and beauty that merits the highest levels of protection and restoration. Accordingly, in 1983, 1987, and 2000, the States of Virginia, Maryland, and Pennsylvania, the District of Columbia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency signed historic agreements that established the Chesapeake Bay Program partnership to protect and restore the Chesapeake Bay's ecosystem.

As the largest Federal owned system of lands and waters in the Bay ecosystem, the Refuge Complex, by encompassing more than a third of the Bay's tidal marshlands in Maryland, plays a critical role in supporting the regionally renowned Chesapeake Bay Watershed Partnership, and in protecting the diversity of living resources that the Chesapeake 2000 Agreement was developed to protect. In a regional context, the Refuge Complex is interconnected to the Bay's living resources and the importance of protecting the entire natural system. Thus, management actions on the Complex are integrated and coordinated throughout the region to assist in achieving the following goals of that agreement.

1. Restoring, enhancing, and protecting the finfish, shellfish, and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem;

2. Preserving, protecting, and restoring those habitats and natural areas vital to the survival and diversity of the living resources of the Bay and its rivers;

3. Achieving and maintaining the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health;

4. Developing, promoting, and achieving sound land use practices which protect and restore watershed resources and water quality, maintain reduced pollutant loading for the Bay and its tributaries, and restore and preserve aquatic living resources; and

5. Promoting individual stewardship and assisting individuals, community based organizations, local governments and schools to undertake initiatives to achieve the goals and commitments of the agreement.

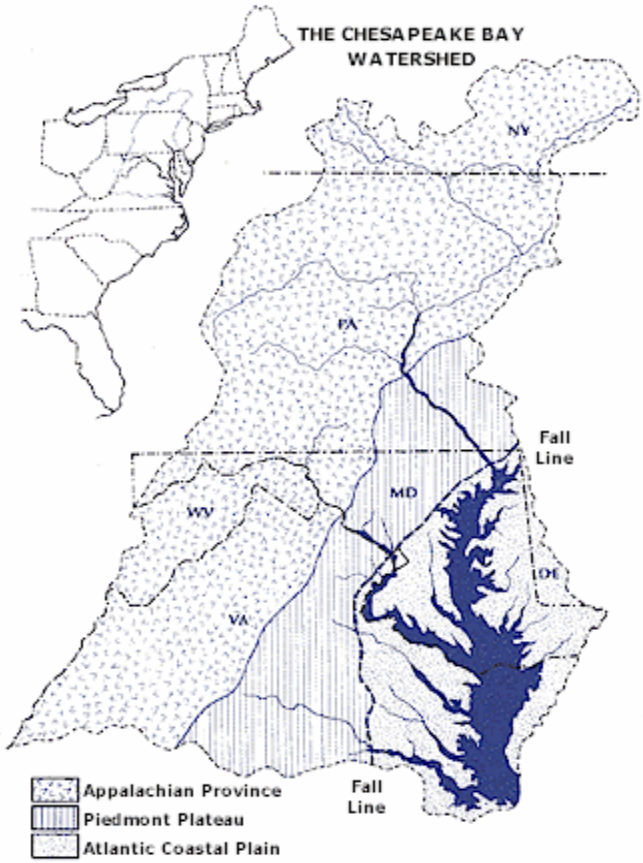


Figure 3.2. Regional context

Another contribution of regional importance and significance is the role the Refuge Complex plays in the Atlantic Coast Joint Venture, a component of the NAWMP. As a major part of a focus area identified by the Atlantic Coast Joint Venture, the Refuge Complex contributes to achieving their primary goal, which is to "provide for the long-term conservation of wetland habitats and their associated wildlife." Another major goal of the joint venture is to restore and maintain migratory bird populations at 1970 levels. Specific population targets and habitat objectives are listed in the Atlantic Coast Joint Venture Implementation Plan. About 1 million waterfowl, or about 35 percent of all waterfowl in the Atlantic Flyway, winter on Chesapeake Bay. The Refuge Complex provides significant diverse habitats to support those waterfowl.

As well as contributing to wetlands protection and restoration and the protection of significant migratory bird populations, the Refuge Complex is recognized regionally for its role in protecting Federal-listed endangered species, particularly, the American bald eagle and the Delmarva fox squirrel. The Refuge Complex supports the largest nesting population of the former species north of Florida on the Atlantic coast, and the largest extant population of the later. The Refuge Complex also provides vital wetland habitat that supports regionally important fin and shellfish fisheries. The adjoining Fishing Bay is the Chesapeake Bay's number one producer of blue crabs, and Martin NWR is the largest producer of soft-shelled crabs in the Bay.

The Refuge Complex is renowned as a regional ecotourism attraction, and many people from the metropolitan areas of Baltimore and Washington, D.C. frequently travel to these refuges, particularly Blackwater, to enjoy wildlife dependent recreational activities, including bird watching, wildlife observation, photography, hunting, and fishing. The Refuge Complex's environmental education program is well established and contributes to the education of thousands of students throughout the region annually.
This watershed consists almost entirely of low lying tidal and non-tidal wetlands, which combine to form most of

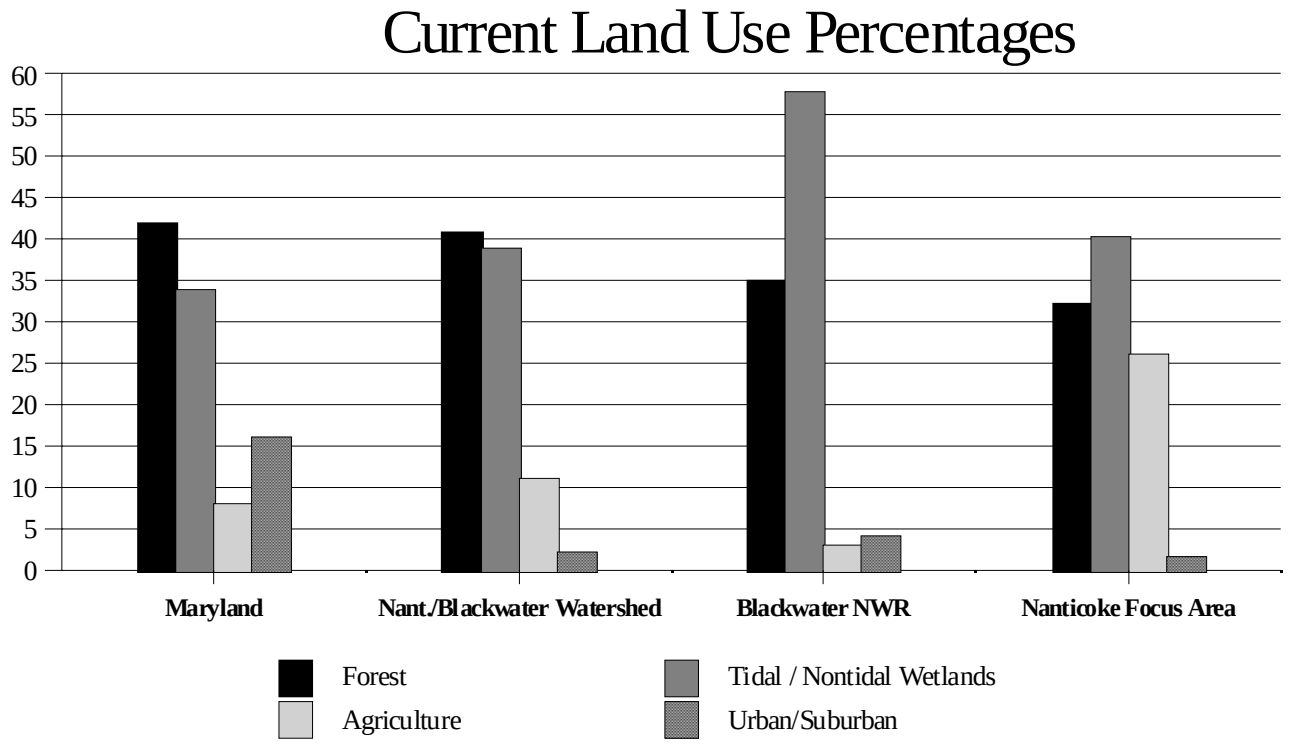


Figure 3.3. Current land use

Blackwater NWR and Fishing Bay Wildlife Management Area. To the east of Fishing Bay is a low marshy peninsula that connects the mainland to Elliotts Island and separates the Blackwater watershed from the Nanticoke drainages until they eventually join in Tangier Sound. Lacking major cities, dams, industrial facilities, or residential developments along much of the lengths of these rivers, the Nanticoke and Blackwater watershed has long been regarded as one of the most pristine and ecologically significant major watersheds in the mid-Atlantic region.

Federal and state natural resource agencies and numerous private groups, including land trusts, non-profit organizations, citizen alliances, and corporations, have long recognized the watershed's natural features and environmental qualities, and are working to preserve the wonders of this magnificent watershed in a landscape context.

Partners in protecting this landscape include, but are not limited to,

- The U.S. Fish and Wildlife Service and its protection and management of the lands and waters of the Refuge Complex; Delaware and Maryland and their respective Nanticoke and Fishing Bay Wildlife Management Areas;

- The Chesapeake Bay Foundation and its environmental education and outreach efforts on the Nanticoke R. and at its many residential environmental education facilities at Bishops Head, Fox Island, Smith Island, and Tangier Island;
- The Lower Shore Land Trust and Eastern Shore Land Conservancy and their efforts to protect lands by establishing easements and other landowner agreements;

- The combined advocacy and outreach of community-based organizations, such as the Friends of the Nanticoke River, the Wicomico Environmental Trust, The Nanticoke Watershed Alliance, and the Nanticoke Watershed Preservation Committee, and the resulting united confederacy of these and other organizations;

- Chesapeake Forest Products, Inc. and their assistance in developing sustainable forestry practices in the watershed;

- The Association of Forest Industries and Maryland Forest Association, working with Federal and state agencies to develop a regional Habitat Conservation Plan that will protect endangered species and sensitive habitats throughout the current natural range of the Delmarva fox squirrel in Maryland, and;

- The Nature Conservancy and The Conservation Fund, both active in acquiring and protecting important land parcels and forging partnerships throughout the watershed.

Relative Sea-level Rise and Its Effect

The Bay attained its present configuration by the time the first European and colonial maps were prepared, but as tide gauges and the continued inundation of low-lying areas indicate, relative sea level in the Bay is still rising. Sea levels have varied greatly from region to region in the past 10,000 years. Sea level is measured relative to fixed points on land, but the elevation of the land also changes due to natural subsidence and uplift of the Earth's crust. If the land surface is subsiding at the same time that ocean volumes are increasing, then the rate of submergence will be greater than it would be due to changes in ocean volume alone. If the land area is rising relative to the sea, apparent sea level may fall.

USGS reports that "continuous tide gauge records around the Chesapeake Bay show that the rate of sea-level rise during the 20th century has not been constant and that modern rates are more rapid than those determined by geologic studies conducted two decades ago…. The current rate of sea-level rise at the mouth of the Chesapeake is about 4 millimeters per year (about 1.3 feet per century) and decreases northward. Tide gauges with longer periods of record, like that at Solomons Island, Md. [see figure 3.4 (NOAA 1998)], midway along the length of the Bay, have recorded mean sea level since 1937, and illustrate a 3-millimeter per year rate of rise (about 1 foot per century)."[1] This rate of sea-level rise is almost twice that of the worldwide average. But why is sea-level rise so much greater here than elsewhere, and what are the effects of the invading sea on the human environment?

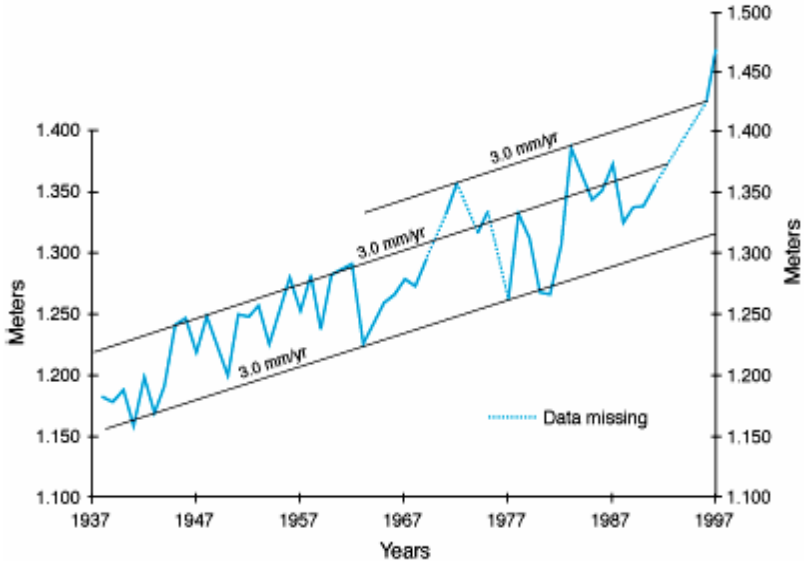


Figure 3.4. Annual mean relative sea level at Solomons Island 1937 - 1997

The effects of this increase in relative sea level are very obvious. Entire communities, such as those on Barren Island and Hollands Island, literally have vanished beneath rising waters. The marshes of the lower Eastern Shore are being swallowed up as the waters advance on the forests, which leave behind their dead snags as reminders that the sea continues to rise.

As to its cause, scientists disagree. Is the increase caused by land subsidence? Is it related to a changing climate and ocean volume? Or, is it a combination of the two? Anthropogenic causes, such as ground water and oil extraction, can cause sediment compaction, which results in land subsidence. On a much larger scale, however, a zone of subsidence along the entire mid-Atlantic coast has been attributed to a reflattening of the

[1]USGS Fact Sheet 102–98

Earth's mantle that is still taking place, following the removal of vast thicknesses of glacier ice to the north thousands of years ago (isostatic adjustment).

USGS reports that the Chesapeake Bay has also been identified as one of four anomalous areas along the U.S. East Coast that appear tectonically active. A zone of crustal downwarping and sediment accumulation known as the Salisbury embayment has long been recognized beneath the Delmarva Peninsula. Clearly, vertical movement can occur along such zones. Another geologic factor that might account for unusual rates of sea-level change, at least for the mouth of the Bay, is possible subsidence related to compaction of the fill of a large buried impact crater that underlies much of the Norfolk, Hampton Roads, and Cape Charles area.[2]

Unquestionably, the rate of sea-level rise has certainly accelerated in the Chesapeake Bay, and this appears to be the norm rather than the exception. The future of the ecosystem, and certainly the Refuge Complex, revolve around understanding, coping with, and more importantly, planning for an ongoing dynamic Earth process like sea-level change.

Erosion and Sedimentation

Natural and anthropogenic processes of erosion and deposition are constantly at work within the Chesapeake Bay. The rivers and tributaries carry silt from the Appalachian and Piedmont Provinces and deposit them in the Coastal Plain. The current marshlands of the Chesapeake Bay are built upon these deposits, which have accumulated as the result of accelerated deforestation and agricultural expansion during the last 350 years. The sediments that are transported by the major rivers also drop out into "sediment traps" such as Baltimore Harbor, or eventually are deposited into the ancient river bed of the Susquehanna and shipping channels, making the need for maintenance dredging an ongoing problem and hotbed of contention.

Marsh grasses colonized the delta-like alluvial plains, characteristic of the historic Choptank and Nanticoke drainages. Over time, these areas have accreted, as additional sediments and organic deposits continue to build the marsh surface. However, as sea levels have continued to rise, sediment rates are being exceeded by erosion, and the peat layers that overlie the coarser sediments of the lower Eastern Shore marshes literally are being dissolved by interactions with the invading salt water. It is not uncommon to lose 10 feet or more of shoreline on Chesapeake Bay islands annually, and upwards of 7,000 acres of highly productive marshland vegetation on Blackwater NWR alone have succumbed to the rising salt water in just the past 60 years.

Table 3.1. Chesapeake Bay physical characteristics

Length	195 mi.
Width	4 to 30 mi.
Average depth	21 ft.
Greatest depth	174 ft.
Drainage area	64,000 mi.^{2}
Wetlands	498,000 ac.
Surface Area	
Bay proper	2,500 mi.2
Bay and tributaries	4,400 mi.2
Shoreline	
Bay proper	4,000 mi.
Bay and tributaries	8,100 mi.

Salinity and Tides

The Chesapeake Bay holds close to 18 trillion gallons of water. If the entire tidal system were drained and the ocean blocked from entering the Bay, more than a year would pass before all the rivers, streams, and annual storm runoff could fill the basin. An estimated average of 70,000 ft^3 of water flows into the Bay each second from all its tributary sources. This freshwater flow represents only one-ninth of the volume of seawater flowing into the Bay at any instant, however, the influence of this disproportionate ratio of fresh to salt has a profound influence on the estuary and its natural resources. This is predominantly because of two important factors: storms and the size of the watershed relative to the volume of the brackish water basin. Here the Chesapeake excels once again.

The watershed spans an amazing 64,000 square miles into six surrounding states. Thus, any storm can have significant influences on the Bay's water quality. Of the 150 rivers, creeks, and streams draining the watershed, only 40 are considered major tributaries, and 8 of these provide 90 percent of the freshwater inflow. Six of these, previously mentioned, drain the western shore. The Susquehanna, which provides 50 percent of the freshwater,

[2]Ibid.

flows from the north, and the lone Choptank drains only part of the Eastern Shore. Thus, White calls the Chesapeake right-handed and top-heavy (White, 1989).

Salinity obviously varies according to the amounts of freshwater these eight major tributaries contribute to the Bay. Generally, salinity increases seaward as mixing slowly takes place. Circulation and mixing are slow, because the fresh water is more buoyant than salt water. The resulting salinity contours, or isohalines, shift according to seasons of the year and freshwater input, and have significant seasonal effects on the Bay's living resource. In April, for example, salinity of the water near the Bay Bridge may be as low as 7 ppt (parts per thousand), but by October following a dry summer, the salinity can be almost twice that amount.

Another interesting natural phenomenon, known as the "Coriolis force,"[3] causes flowing waters in the northern hemisphere to be deflected to the right due to the earth's rotation. This condition has significant impact on the Eastern Shore, because the saltier waters moving up the estuary are pulled towards the eastern side of the Bay, where there is less freshwater input. The combined power of the western rivers and the Coriolis force create a counterclockwise circulation in the Bay, with the incoming salt water entering along Cape Charles and hugging the Eastern Shore, and freshwater exiting along Cape Henry and the western shore. This circulation and salinity pattern has definite influences on the estuary and its ecosystem.

Table 3.2. Salinity zones of the Chesapeake Bay estuary

Ecosystem	*Zone*	*Venice System*	*Salinity*
Riverine	Nontidal freshwater	Fresh	0 ppt
Estuarine	Tidal limit	Tidal freshwater	Fresh: 0–0.5 ppt
Upper bay/upper tidal rivers	Low brackish	Oligohaline	0.5–5 ppt
Mid-bay/lower tidal rivers	Brackish	Mesohaline	5–18 ppt
Lower Bay	High brackish	Polyhaline	18–30 ppt
Marine	Marine	Euhaline	>30 ppt

Tides, too, have great influences on the ecosystem. The vertical range of tides in the Bay is greatest at the capes (2.5 ft.), intermediate through the main Bay where it averages 2 ft., and lowest along the upper reaches of tidal streams (1 to 2 ft.). Twice each day these natural forces expose and submerge shorelines and transport nutrients. On an average, it takes a parcel of water about 2 to 3 weeks to cycle along the Bay's 195-mile length, and each second, the surface stream discharges nearly 700,000 cubic feet of brackish water into the ocean; 10 times greater than the average freshwater input.

Bay Wetland Ecology

The estuary basin's salinity gradient and topography control the distribution of life and the number of species within the Bay. Five major communities within the estuary provide habitat for 2,700 species of aquatic and wetland plants and animals. These communities can be further segregated into freshwater, low brackish, moderately brackish, and highly brackish zones along the length of the Bay or its tributaries. Within each zone, species composition varies depending on local shifts in salinity, elevation (depth), sediments, and topography of the substrate. All of the following Bay communities are represented on the Refuge Complex.

Wetlands.—Surrounding the Bay are 498,000 acres of emergent wetlands. Kept wet by runoff, groundwater seepage, adjacent stream flow, and tides, these habitats range from shrub swamps and cattail marshes along secluded streams to the open salt marshes of the lower Bay. In addition to trapping sediments, recycling nutrients, and providing numerous other hydrologic and energetic benefits, these wetlands are the most productive plant communities in the world.

[3]**coriolis force** *n., usu cap C*: the force corresponding to the Coriolis acceleration of a body equal to the product of the mass by the Coriolis acceleration and responsible as a result of the Earth's rotation for the deflection of projectiles and the motion of the winds to the right in the northern hemisphere and to the left in the southern hemisphere—Webster's Third New International

Submerged Grass Beds.—Another major community that only consists of fewer than 36 species that live in shallow waters of rivers, streams, and the Bay proper are collectively known as SAV.

Plankton.—This community includes phytoplankton, zooplankton, bacteria, and large jellyfish. The tiny, floating larvae of benthic animals and fish, known as meroplankton are, for a short time, part of this community as well.

Nekton.—The larger aquatic organisms capable of swimming that form this community include fish, crustaceans, and other invertebrates. Nearly 300 fish species can be found in the Bay ranging from the permanent residents like silversides and white perch, to freshwater and marine species, to migratory anadromous and catadromous species.

Benthos.—Inhabitants of the bottom sediments are commonly known as benthos. Benthic communities, often described in terms of animal groups such as oyster beds, also include algae, bacteria, and ciliates. Intertidal species are a special class of bottom dwellers that can survive temporary exposure to air.

Freshwater Swamps

Wet, soggy habitat located at the headwaters of many Bay tributaries is known as "freshwater swamp." These are seasonally saturated or permanently flooded wetlands with a greater than 50-percent coverage of woody vegetation. Swamps, unlike bottomland forests, are saturated to the surface or flooded by up to a foot of water. In the Bay, wooded swamps typically are dominated by red maple/green ash, bald cypress, loblolly pine, or occasionally Atlantic white cedar.

Unforested shrub swamps typically contain swamp rose, alder/willow, or maple/ash seedlings in linear thickets along creeks or adjacent to freshwater marshes. Freshwater swamps consist of herbs, vines, shrubs, and trees entangled into a wetland jungle.

Freshwater Tributaries and Adjoining Freshwater Marshes

More than 150 tributaries contribute fresh water to the Chesapeake Bay. Of these, nearly half are tidal, and run either full-length into the estuary or converge with larger estuarine rivers before entering the Bay. River marshes are divided into two types: freshwater estuarine river marshes upstream and brackish-water estuarine river marshes downstream. Since the freshwater stream and adjoining freshwater marshes are interconnected, they are most often viewed as one integrated habitat. In the stream, aquatic species dominate, and, in the marsh, wetland species reign. Tidal fresh water is defined as the narrow region of the salinity gradient between 0 ppt (parts per thousand) and 0.5 ppt. Because of the indefinite boundary between fresh and brackish regions of a given river, plant composition is used to define the wetland habitat.

Marshes are typically covered with a few inches of water at mean high tide, though the community may extend to the spring or storm tide limit. The plants are generally herbaceous (i.e., non-woody) species, unlike freshwater swamps. Emergent plants far outnumber both floating-leaved plants and the SAV in the stream channel. While shrubs and trees may grow at the upland (or swamp) margin, they are not typical of the marsh community. The shading canopy of trees limits the growth of herbaceous species at these margins, and, when overhanging a creek, may prevent sunlight from reaching and nurturing SAV.

Freshwater marshes are colonized by indicator plants. Important species include broad-leaved cattail, which grows in stable shallow-water areas; river bulrush, which typically grows in bands at the river edge; tall grasses, particularly wild rice and Walter's millet; smartweeds and tearthumbs; and, in shallow open water, spatterdock, arrow arum, and pickerelweed. In elevated areas of the marsh, swamp type shrubs, such as buttonbush, sweet pepperbush, or silky dogwood are found. In addition to these shrubs, red maple and common alder may colonize the marsh edge, representing the transition (and succession) of marsh into woody swamp. Compared to salt and brackish marshes there is a more heterogeneous mixture of plants. Freshwater tidal tributaries provide habitat important for transient anadromous and catadromous species, such as shad and river herrings and American eel, respectively.

Estuarine Rivers and Brackish Marshes

More than 45 major rivers flow directly into the Chesapeake Bay. Each river has a salinity gradient that can vary greatly along its length. These estuarine rivers and their associated brackish marshes are important breeding and nursery grounds for fish and birds. In summer, marsh hibiscus blooms along the banks amidst stands of big cordgrass and narrow-leaved cattail.

Brackish waters are broadly defined as the middle range of the salinity gradient between tidal fresh water and marine. A lot of territory in the Bay (or any estuary) falls in this range; in fact, during autumn the entire Chesapeake (and some of its shorter rivers) may be brackish, that is, between 0.5 and 30 ppt. The brackish salinity gradient, therefore, is divided into three brackish zones: oligohaline (0.5–5 ppt), mesohaline (5–18 ppt), and polyhaline (18–30 ppt), which can be termed low (or slightly) brackish, moderately brackish, and highly brackish, respectively.

Indicator species include narrow-leaved cattail, Olney three-square, switchgrass and common reed, along with associated species such as hibiscus, tidemarsh water hemp, and saltbushes. Additional plant communities include big cordgrass and black needlerush. These plants must be able to survive a wide range of salinities. The most characteristic brackish-wetland species for example, Olney three-square, can grow in waters from 1 to 18 ppt. These marshes are home to muskrats, the infamous nutria, and other wetland mammals.

Fresh Estuarine Bay Marshes

Between the mouths of the Susquehanna and Sassafras rivers north of Baltimore, there is a 12-mile stretch of tidal fresh water marsh. Bordering these waterways and south to the Gunpowder delta is a limited acreage of fresh bay marsh that is very similar in plant composition to the wetlands along freshwater streams. The most extensive area of fresh bay marsh, however, is located landward of the brackish bay marshes in Dorchester County, Maryland, at the headwaters of the Blackwater River. Other Dorchester County rivers, the Transquaking and Chicomicomico, are also noted for these unique wetlands. These marshes are diverse and abundant with aquatic and wetland life.

The term “fresh bay marsh” is considered by some to be a misnomer. Because the estuary has a measurable salinity gradient along its length, one may logically expect fresh water to be absent, a pure form sequestered only in the headwaters of the tributaries. But in these habitats, freshwater species exist in abundance as long as seasonal brackish inundation is not prolonged. Major indicator plants include narrow-leaved cattail, Walter’s millet, American three-square, wild rice, smartweed, fragrant waterlilly, and spatterdock.

Brackish Estuarine Bay Marshes

The middle of the Chesapeake is dominated by brackish marshes. In these moderately brackish waters, there is the transition from the taller plants of the freshwater marshes to the low-lying salt meadows of the lower Bay. Only very small pockets of bayside brackish estuarine wetlands remain on the western shore between the Patapsco and the Patuxent. The largest contiguous acreage, more than 90 percent of the Bay’s total, is found on the Eastern Shore, mostly in Dorchester County, Maryland, in the Blackwater/Fishing Bay/Nanticoke River watershed. Most of these brackish wetlands are three-square meadows (*Schoenoplectus* spp.), with taller big cordgrass or narrow-leaved cattail along the margins of tidal creeks and ponds.

These *Schoenoplectus* marshes differ from brackish river marshes in having a broad, ill-defined drainage system. Slight changes in the marsh topography and waterfowl, nutria, or muskrat “eat-outs” may foster shallow tidal pools, or marsh ponds. These ponds are important habitat for migratory waterfowl. Submersed aquatics (SAV), particularly the pondweeds *(Potamogeton* spp.) grow here. Brackish bay marshes dominate areas inundated by slightly brackish (oligohaline) to moderately brackish (mesohaline) waters. The most important plant indicators include Olney three-square which grows in peaty soils with saltmarsh bulrush, hightide bush, dwarf spikerush, black needlerush in the sandier soils, switchgrass, big cordgrass, and common reed.

Salt Marshes

Salt marshes of the lower Bay extend for miles and miles, encompassing Taylors Island, the Honga River, Elliotts Island, Worlds End Creek, South Marsh Island, Watts Island, Tangier Island, and Smith Island. They extend on into Tangier Sound and stretch toward the mouth of the Chesapeake Bay. In some cases, entire islands, such as Bloodsworth and Great Fox, are overrun with black needlerush, the dominant vegetation. These vast wetlands are flat and monotonous. Only where small elevated islands appear does the eye find relief. There, in wax myrtle and loblolly pine jungles, egrets and herons nest in the Bay's largest and most productive colonial bird heronries. Only the willet, the clapper rail, and a few others reside in the marsh.

Salt marshes are a hostile environment. Few species, either plant or animal, can survive. A salt marsh may be defined quite simply as "Spartina- and Juncus-dominated wetland." Typically, only three species predominate: saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), and black needlerush (*Juncus roemerianus*). Saltmarsh cordgrass grows in tall colonies along tidal creeks below mean high tide (MHT) and in shorter stands at or above MHT. The tall form characterizes what is often referred to as the "regularly flooded salt marsh," or low marsh, while the short form of cordgrass (growing behind this zone) intergrades with the salt meadows of the irregularly flooded salt marsh, or high marsh. Saltmeadow cordgrass grows in large meadows in the high marsh where the soil is well drained; in wetter (lower) areas of the high meadow, saltgrass (*Distichlis spicata*) may persist.

The waters that flood these wetlands typically have salinities in the upper mesohaline range (10 to 18 ppt) and above. In this range, black needlerush and saltmarsh bulrush (*Scirpus robustus*) can still survive and compete with *Spartina*. The transition to pure cordgrass meadows takes place at a point farther north on the Eastern Shore than the western shore due partly to the Coriolis force. These salt marshes are the most productive plant communities on earth, producing a range of 4 to 10 tons of organic matter per acre per year.

Beaches and Tidal Flats

The shoreline of the Chesapeake Bay stretches for more than 4,000 miles around the basin. The banks of tributary rivers and streams double this figure to more than 8,000 miles. Unvegetated wetlands border most marshes and beaches from the mouth of the Susquehanna to Capes Henry and Charles. Unvegetated wetlands may be defined as wet substrates, devoid of rooted plants, that are subjected to tidal inundation. This definition includes streambeds, unvegetated shallows, and open water below mean low tide (MLT); sandbars and mud flats exposed at low tide; as well as sandy beaches. Upper beaches represent the shoreline continuum above MHT, only reached by storm and spring tides and salt spray.

The shoreline is divided into four distinct zones based on elevation relative to tidal fluctuations. Below MLT is the subtidal zone, which includes submersed aquatic vegetation and benthic algae, as well as unvegetated shallows. Between MLT and MHT is the intertidal zone, which may be muddy, sandy, or a mixture of these. In this zone, a variety of snails, clams, and burrowing worms are found in the substrate. Above MHT, up to and somewhat beyond the limit of spring tides is the supratidal zone, which may support scattered plants. This is the area of dry sandy beaches where sand fiddlers dig their burrows, and where dips, or pannes, in the sand foster salt barrens where salt-tolerant plants (*halophytes*) are found. Above the supratidal zone is a transition zone, or ecotone, colonized by species such as wax myrtle and loblolly pine. Densities of major invertebrate groups range from 330–3,000 individuals per square meter on sandbars, to 5,300–8,300 individuals per square meter on richly organic sand-mud flats.

Shallow Water Habitats

Shallow waters are where much of the Chesapeake's remarkable productivity occurs. The Bay averages 21 ft (6.4 m) deep. Additionally, much of the basin is covered by less than 10 ft (3 m) of water. These shoal areas allow sunlight to reach the Bay floor, permitting photosynthesis in both the water and benthos. These shallow waters host 3 important plant communities: phytoplankton, benthic algae, and SAV.

Deep Open Water

The open Chesapeake is seasonal habitat: a summer haven for marine fishes and a winter refuge for migratory waterfowl. True estuarine species that remain in the basin year-round, such as the Bay anchovies, retreat to deepwater channels in winter. In spring, they return to forage along channel edges, and serve as prey for visiting bluefish and other large predatory fish that return from their Atlantic winter retreat. The biannual migrations of marine and anadromous fishes into and out of the Bay are well known to fishermen. Ten anadromous species migrate through the Bay to spawn in freshwater tributaries in early spring. Also, 152 marine species may visit the estuary in summer as foraging adults or juveniles, but most depart by autumn. Six marine species are regular visitors in winter. Only 27 estuarine species (and 2 marine species) are permanent residents.

The open Bay, varying between 4 and 30 miles wide, can be divided into shoal, or shallow, areas and deepwater habitats. Shallows less than 10 ft (3 m) deep hug the shoreline of the Bay and its tributaries. Shoulders, less than 30 ft (10 m) deep, are the next step down and border the edges of the main and tributary channels, which run deeper than 60 ft (20 m). The main channel, the ancient riverbed of the Susquehanna, is more than 100 ft (30 m) deep for much of its length. The deepest point of the Bay, off Bloody Point just south of Kent Island, is 174 ft (53 m). The shoulders, channel edges, channels, and deep holes constitute the deepwater zones of the Chesapeake Bay. More than 50 of the Bay's 287 fish species are commercially valuable, and income for commercial fisheries and associated industries exceeds $100 million annually.

Landforms

To understand the origin of these landforms, it is necessary to first consider the larger context of the geologic evolution of Chesapeake Bay and the Atlantic Coastal Plain. The geologic evolution of Chesapeake Bay can be divided into three sequential time periods: the Tertiary Period, the Pleistocene Epoch, and the Holocene Epoch. Each period has been studied; but fundamental questions remain, because of significant gaps in the geologic record.

The Delmarva Peninsula was formed during the upper Tertiary Period (1.8–10 million years ago) by regional uplift and emergence of the Coastal Plain along with deltaic and shallow-water marine deposition. The oldest of the major formations of this phase are the Miocene and late Miocene (5–10 million years ago) gravel sheets, which are the Brandywine, Bridgeton, and Pensauken formations (Owens and Denny 1979). These sheets were deposited by streams that transported material down to New Jersey and the Delmarva Peninsula from a source area in the vicinity of present-day Long Island. Overlying the gravel sheets are uplifted Pliocene (1.8–5 million years ago) shallow-marine formations, including the Beaverdam Sand and the Yorktown Formation (Mixon 1985; Toscano and York 1992). The top of the Tertiary sequence is an erosional surface thought to be cut by many episodes of sea-level regression (Mixon 1985; Toscano and York 1992).

Once the Delmarva Peninsula and adjacent Susquehanna River valley had been formed, the Pleistocene evolution of the system was marked by alternating periods of marine-estuarine deposition during high sea stands and fluvial down-cutting during low sea stands. Three generations of the paleo Susquehanna River channel have been revealed beneath the Chesapeake Bay and lower Delmarva Peninsula by seismic reflection profiles (Colman et al. 1990; Colman et al. 1992). The oldest paleo channel, the Exmore, is now thought to be 200,000 to 400,000 years old. The centerline of the paleo bay during the post-Exmore interglacial period went through the Honga River and the southwest corner of present-day Blackwater NWR. The center of the mouth of that paleo bay was located at Parramore Island and Wachapreague, about 50 miles (80 km) north of the present-day mouth of Chesapeake Bay. The primary depositional unit during the early Pleistocene was the Omar Formation (Toscano and York 1992).

The second paleochannel in the sequence, the Eastville, is presently thought to be 150,000 years old. In the vicinity of Blackwater NWR, the Eastville channel is broken into two main branches; the eastern branch underlies the present Honga River shoreline and westernmost Blackwater NWR. During the subsequent high stand of sea level, which lasted from about 125,000 to about 80,000 years ago, the vicinity of Blackwater NWR would have been the sandy bottom of a paleo bay. The Kent Island Formation underlying Blackwater NWR and vicinity has been dated to this time period on the basis of amino acid racemization, palynological evidence, and uranium series dating, and is thus estuarine in origin (Mixon 1985; Toscano and York 1992).

From 80,000 to 10,000 years ago, sea level was 80 to 400 feet (25 to 120 m) lower than the present level. During that period, the Cape Charles paleo channel was cut and the surface of the Kent Island Formation on the western flank of the Delmarva Peninsula was reworked by rivers and winds. Wetlands, including bogs and swamps, formed at various locations throughout this period. Peat samples from these wetlands have been dated to 13,000–30,000 years ago (Denny and Owens 1979). On parts of the central Delmarva Peninsula, wind action reworked deeply weathered exposures of Omar Formation beach and near-shore sands to form a surface cover of dunes known as the Parsonburg Sand Formation (Denny and Owens 1979). Exposed ridges of Parsonburg Sand Formation dunes are well documented on the central and eastern Delmarva Peninsula (Denny and Owens 1979; Hall 1973; Matthews and Hall 1966), but until a geomorphological reconnaissance study was completed in May 2000, they had not been identified on Blackwater NWR.

The most recent epoch, the Holocene, began 10,000 years ago. During this period, wind was responsible for transporting silt over the Delmarva Peninsula, where it formed deposits ranging between 1 to 8 feet (30 and 236 cm) in thickness (Foss et al. 1978; Markewich et al. 1986). Foss et al. (1978) found that the deposit is relatively thick near the ancestral Susquehanna River and thins toward the east, suggesting that the aeolian source was Pleistocene outwash sediments. Radiocarbon determinations indicate a post-11,000 b.p. deposition. These aeolian gray silts form a veneer across the region, and are now generally poorly drained.

Topography

Blackwater NWR.—The area is characterized by little relief, and elevations range from below mean sea level to approximately 8 feet (2.5 m) above mean sea level (amsl). Landforms on Blackwater NWR include the local topographic highs (lowland flats) located in swamps such as Parsons Creek Neck, Green Brier Swamp, Kentuck Swamp, and Buttons Neck, and a few wooded islands. These swamps have very poor drainage and are thus flooded for part of the year and dry part of the year, in accordance with rainfall seasonality.

Northern tributaries of the Blackwater River, such as Little Blackwater, Buttons Creek, and the unnamed drainage between Peters and Buttons Necks, have broad, low relief wetland swamps. Some of the areas where the swamps border Blackwater River and its tributaries (fluvial banks) have been converted for agriculture and refuge management uses. The Blackwater River floodplain has been inundated by relative sea-level rise and filled with fluvial and estuarine sediment as well as organic peat-yielding tidal marsh. Tidal flats and marsh line the shore of the Blackwater River. A few forested (and deforested) islands such as McGraw Island exist in the tidal marsh.

Chesapeake Island Refuges.—The Island Refuges and Divisions are predominately flat and featureless, with average elevations of 2 feet AMSL, and a maximum elevation of 5 feet AMSL. High ground is limited, but crucial for shrub- and tree-nesting colonial water birds and bald eagles.

Nanticoke Protection Area.—The topography of the proposed protection area is characterized by slight and very localized relief, most of which exists along the middle section of the basin where short but steep slopes are evident immediately adjacent to the river. Elevations range from 62 feet AMSL in the basin's upper reaches, to sea level or below at the intertidal areas at the mouth. The southern end of the Nanticoke watershed is extremely low lying and marshy, with a broken and embayed shoreline.

Lithic Resources

Chert and quartz cobbles have moved down the Susquehanna River valley after being deposited at terminal moraines during glaciation. Local areas where this material is exposed or close to the surface include near Federalsburg in Dorchester County (approximately 25 miles [15 km] northeast of Blackwater NWR); west of Cambridge, Maryland (approximately 7 miles [4 km] north of the main body of Blackwater NWR); the mouth of the Nanticoke River (approximately 15 miles [9 km] southeast of the main body of Blackwater NWR), and near the towns of Upper Fairmont, Westover, and Princess Anne in Somerset County (approximately 35 miles [21 km] southeast of the main body of Blackwater NWR) (Hughes 1980). Other sources of chert, jasper, rhyolite, and quartzite were available to the inhabitants of the Eastern Shore through trade from southern Delaware, New Jersey, and southeastern Pennsylvania. High quality lithic material such as "Iron Hill Jasper" can be found in outcrops near the ancestral Susquehanna River in New Castle County, Delaware (Custer and Gallaso 1980:2).

Soils

Soils are important in identifying environmentally sensitive and compatible future land uses. We will discuss soil data for each of the three units of the study area: Blackwater NWR, the Chesapeake Island Refuges, and the Nanticoke protection area.

Blackwater NWR.—Soils data for Blackwater and its surrounding focus area included in the approved Preliminary Project Plan for additional land acquisition are compiled in a survey of Dorchester County by Brewer (1995), a recent update of an earlier report (Anonymous 1963).

Soil associations in these areas include Elkton-Othello and Tidal marsh, with the latter type encompassing a majority of the current refuge. The Elkton-Othello association is described as "moderately fine textured to medium-textured soils that are dominantly poorly drained."[4]

Tidal marsh designates areas subject to flooding by salt water. A total of 11 major soil types are present in the survey area. Table 3.3 presents these soil types, their slope, and permeability. The most prevalent are the Bestpitch and Transquaking series, found on estuarine tidal marshes; Elkton series, found on lowland flats and small depressions; Honga peat, found on brackish submerged upland marshes along tidally influenced bays; Othello series, found on lowland flats; and Sunken mucky silt loam, found on lowland flats (Brewer 1995). The better drained soils on the refuge occur only in small, isolated areas. These include Matapeake and Mattapex series, both found on the edges of lowland flats, or the fluvial banks.

Table 3.3. Blackwater NWR soil types

Soil Type	*Permeability*	*Acres*	*Percent of Total*
Bestpitch and Transquaking (BT)	Very poorly drained	5,165.73	22.03
Elkton silt loam (Em)	Poorly drained	2,367.25	10.10
Elkton mucky silt loam (Ep)	Poorly drained	1,727.70	7.37
Honga peat (Hg)	Very poorly drained	1,764.64	7.52
Matapeake silt loam , wet (MkA)	Well drained	23.63	0.10
Mattapex silt loam (MsA)	Moderately well drained	204.78	0.87
Mattapex silt loam (MsB)	Moderately well drained	26.67	0.11
Othello silt loam (Oh)	Poorly drained	1,477.14	6.30
Othello and Kentuck soils (Ok)	Poorly drained	2,009.32	8.57
Sunken Mucky silt loam (Su)	Very poorly drained	2,671.80	11.40
Other Minor Inclusions	N.A.	18.21	0.08
Water	N.A.	5,987.06	25.54
Totals		**23,443.93**	**100.00**

Bestpitch and Transquaking soils formed in moderately decomposed organic deposits from salt tolerant herbaceous plants that overlie clayey mineral estuarine sediments (Brewer 1995:26). Bestpitch and Transquaking soils have a thick, highly organic surface layer; in the Transquaking series this can be up to 51 inches (130 cm) thick. On the refuge this soil type is found on the tidal marshes along Blackwater River. Elkton soils formed in aeolian silt deposits overlying sandy fluvio-marine sediments (Brewer 1995:32). On the refuge this soil type is found on most of Parsons Creek Neck, on most of Buttons Neck, on a large area in the center of Green Brier Swamp, and surrounding the Othello and Kentuck soils on Gum Swamp. Honga soils formed in moderately decomposed organic deposits from salt tolerant herbaceous plants overlying silty mineral sediments (Brewer 1995:47). Honga soils have a thick organic surface layer (approximately 22 inches [56 cm]). This soil type is found on large areas adjacent to Parsons Creek, and along most of the tidal marshes of Blackwater River.

[4]Anonymous 1963: General Soil Map

Marsh deposits on Blackwater NWR began about 3,800 years ago. Many deposits are almost 4 meters thick in the oldest areas of the marsh, but average deposits are between 2 and 3 meters thick. Most of the material is loose, organic muck. The Blackwater and Little Blackwater Rivers are the major sources of inorganic sediments for most of the marshes on the refuge, with occasional storm deposition from Fishing Bay being important for marshes in the southeastern part of the refuge. The emergent marsh is noticeably being replaced by open water through erosion, subsidence, sea-level rise, increasing salinities, and eat-outs from muskrats, nutria, and geese. In the last 100 years, effective sea-level rise (land subsidence added to sea-level rise) has been 12 inches in the Chesapeake Bay area (Leatherman et al. 1995).

Matapeake, Mattapex, Othello, Kentuck, and Sunken soils all formed in loess (silty) deposits overlying sandy fluvio-marine sediments (Brewer 1995:56, 58, 62). On Blackwater, Matapeake soil is found on the banks of Buttons Creek and Little Blackwater River. Mattapex soils are found on the banks of Buttons Creek and Little Blackwater River, and on an island between Wolfpit Marsh and Goose Pond (Middle Ridge). Othello soils are found on the bank of the unnamed tributary to Corsey Creek and on most of Kentuck Swamp. Kentuck soils are found always in combination with Othello soils, and are on the more elevated area above the unnamed tributary to Corsey Creek, on Kentuck Swamp, on most of Green Brier Swamp, on Dragon Swamp, and on small areas of Gum Swamp. Sunken soils are found in large areas surrounding the Honga peat along Parsons Creek, Corsey Creek, and Blackwater River, and on all of McGraw Island.

Metapeake silt loam, mattapex silt loam, and othello silt loam are considered prime farmland. These soil types are found primarily on Hog Range and in the existing farm field along Key Wallace Drive. The U.S. Department of Agriculture recognizes that responsible levels of government should encourage and facilitate the wise use of our Nation's prime farmland because of the importance in meeting the Nation's short- and long-range needs for food and fiber. Elkton loam and elkton silt loam are also very good soil types for farmland if properly drained.

Prior converted (PC) wetland soils, i.e., Class 3 soils, are primarily the wetter Elkton and Othello series. PC wetlands having these soil types can be readily converted to freshwater impoundment systems and forested wetlands. The potential productivity is moderately high for loblolly pine and some hardwood trees (swamp chestnut oak, willow oak, and water oak) on the Elkton and Othello soils. Engineering, recreational, and facility development properties of these soils is found in the Soil Survey Update for Dorchester County.

Chesapeake Island Refuges.—Honga soils are found along the low shorelines of Barren Island, on almost the entire Bishops Head Division, and on all of Spring Island. Matapeake soils are found on central Barren Island and the interior of southern Barren Island, reconfirming the importance of Barren Island as an agricultural community in the 18th and early 19th centuries. Sunken soils are found on some elevated portions of Barren Island, and in small, isolated places on the Bishops Head Division. The Natural Resources Conservation Service has not mapped the soils on Battery Island, due to its small size. The Natural Resources Conservation Service has not mapped the soils on Battery Island, due to its small size.

Nanticoke Protection Area.—The associated Nanticoke watershed is underlain by a seaward-dipping wedge of unconsolidated and semi-consolidated sediments ranging in age from Jurassic to Holocene. Overlying the older deposits is a series of gravels with minor amounts of sandy and silty materials that form steps or terraces in the coastal plain. Two of these terraces form the bulk of the watershed. The Wicomico terrace is found at elevations between 45 and 90 feet above sea level in the upper watershed, while the Talbot terrace forms the lower lands from 10 to 45 feet above sea level.

The upper Nanticoke watershed has mostly well drained soils with some areas of excessively drained sandy soils. Some of the areas of sandy soil are of limited use for agriculture due to drought and low fertility. Agricultural land use includes farm yards, orchards, pasture and cropland. Row-cropped corn and soybeans are planted extensively for use as feed for poultry, which is one of the largest components of the agricultural economy. Most of the lower watershed's soils are poorly drained with large areas of swamp and marsh that are subject to tidal flooding, except for some large areas of very sandy soils in Wicomico County. Poor drainage limits the agricultural value of soils and drainage ditches have been constructed and maintained to drain the area.

Within the Wicomico County portion of the Preliminary Project Proposal focus area, there are four major soil types: Tidal Marsh, Muck, Plummer loamy sand, and Klej loamy sand. Tidal Marsh occupies about 7 percent of Wicomico

County, and most of the tidal marsh in the county is found along the Nanticoke within the protection area, principally south of Maryland Route 50. This series is obviously unsuited for agriculture and forestry.

Muck consists of very poorly drained to ponded, extremely acid, organic soils that lie along the upper Nanticoke above Route 50. In most places, they are forested with a mixture of sweet gums, black gums, and red maples, and are also unsuited for agriculture.
The Plummer series consists of level or nearly level, deep, sandy soils that are poorly drained. These soils formed in sandy marine sediments or very old alluvium. The surface layer of these soils has been darkened by organic matter, and the underlying sand contains mottles, which indicate that air is lacking for long periods each year when the soil is wet. Where the soils are wooded, the native trees are wetland hardwoods and conifers, including red maple, gums, holly, and loblolly and pond pines. In areas that are reforested following clear cutting, loblolly pine grows in nearly pure stands. Because of the wet nature of the Plummer soils and their high water table, there is little agriculture. Ponding is not uncommon during the winter months and early spring. These soils are naturally acid and low in fertility, and primarily suited to maintaining forests.

The Klej series soils are deep, level to gently sloping, coarse textured soils that are somewhat poorly drained or moderately well drained. These soils lie on upland flats and in similar areas where they formed in sandy marine sediments or very old alluvial sediments, commonly underlain by finer textured material. The native vegetation consists of mixed oaks, sweetgum, maple, holly, and some loblolly pine. Most of the series in the focus area is forested. Like Plummer soils, they have seasonally high water tables, but they can be drained by either tile or open ditches. These soils are also naturally acid, and lime and fertilizer are needed if crops are to be grown successfully. Maintaining productivity is very difficult.

Almost every soil type found within Dorchester County exists on that portion of the Preliminary Project Proposal focus area located in Dorchester County. It is particularly interesting to note the large diversity of soil types found at the confluence of the Marshy Hope and Nanticoke Rivers.

Water Resources and Hydrology

Unconsolidated sediments underlie the Coastal Plain, including all of the estuarine wetlands. The area derives its groundwater recharge mainly through infiltration of precipitation. Discharge occurs through seepage to streams, estuaries, and the ocean. Coastal wetlands are in these discharge zones. These wetlands have complex hydrology, in which stream flow, groundwater flow, and tidal flow all play a part. Forested wetlands occur along the stream channels, and are sustained by local and regional groundwater flow and flooding during storms. The poorly drained interior of the Delmarva Peninsula has a system of depressional palustrine wetlands, narrow bands of palustrine wetlands along rivers and ditches that drain from inland to the coasts.

Susquehanna NWR.—The small, 1.5-acre Edmondson Island (Battery Island/Shad Battery) is surrounded by the waters of the upper Chesapeake Bay. The island and surrounding ‘flats’ are influenced greatly by the Susquehanna River. Surface water is derived from local precipitation.

Blackwater NWR.—The main section of the refuge is drained by the Blackwater River, which empties into Fishing Bay to the southeast, a large shallow embayment at the north end of Tangier Sound. Major tributaries of the Blackwater River include Buttons Creek, Little Blackwater River, and Backgarden Creek on the north flank, and Meekins Creek, Coles Creek, and Raccoon Creek on the south flank.

The upper two-thirds of the Blackwater River is separated from the lower third by Maple Dam Road, which is a substantial barrier for water, sediment, and chemical transport. Maple Dam Road, also called Shorters Wharf Road, runs north and south along the west side of Green Brier Swamp and then through the marshes for approximately 6.1 miles (10 km) with no culverts. The road was first established in the early 1900's, and sometime before World War II was built up with oyster shells and dredge spoil (Pendleton and Stevenson 1983:143). The north and south ends of Maple Dam Road are first depicted on Martenet’s 1865 map, but are separated by Keenes Ditch. A 1934 map shows the north end of the road, from Cambridge to a point directly east of Church Creek, as an improved county connecting road; the section that continues to Shorters Wharf is shown as a state road; and the section from Shorters Wharf to Lakesville was an unimproved county connecting road (Hoen & Co. 1934). The road was paved and raised several times, and Pendleton and Stevenson (1983:145) reported that in the mid-1960's the road was at an

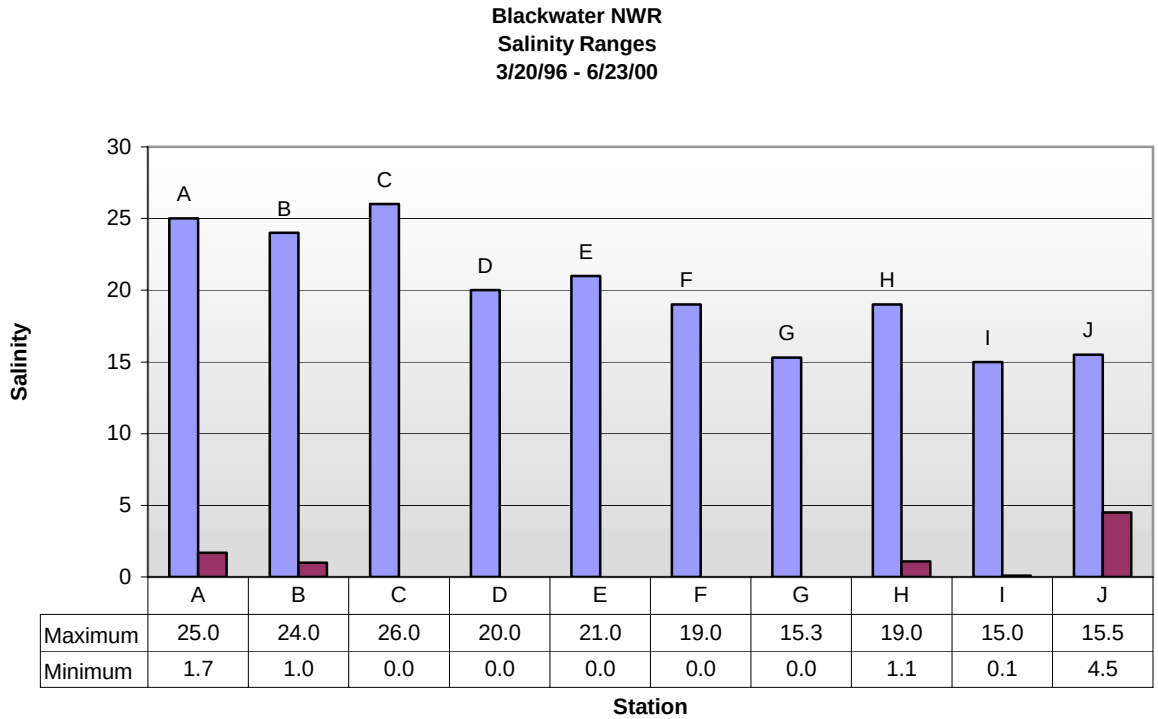
elevation where it was no longer flooded on a regular basis. However, the road currently continues to flood during most spring tides at several places from Wolfpit Marsh to the Blackwater River bridge at Robbins.

Historically, Blackwater River and Parsons Creek were not connected. According to the cartographic evidence, sometime between 1850 and 1865 Parsons Creek was channelized to accommodate the removal of timber (Cowperthwait 1850; Martenet 1865). An 1850 map does not depict a channel extending off of Parsons Creek. The next map of this area found during a recent archaeological and geomorphological reconnaissance (USFWS Contract No. 50181-7-C062) is the 1865 map by Martenet, which shows "Stewart's" Canal connecting Parsons Creek and Big Blackwater. Sometime between 1865 and 1877 another canal or ditch was excavated to facilitate boat travel following Corsey Creek up to Tobacco Stick Bay, now Madison Bay. After this point, only the marshes between the headwaters of Blackwater River and Parsons Creek provided a filter protecting Blackwater River from the influx of salt water from the Little Choptank River. Marsh loss, caused by excessive herbivory by nutria and accompanying salt water intrusion, has recently allowed a connection between Parsons Creek and the head of Blackwater River, so the river is now tidally influenced from both ends. This breach was first noticed in 1989.

Figure 3.5 indicates salinity trends at locations on Blackwater NWR. The salinity data from 1944–1946 were derived from chlorosity (g Cl- / L) using this formula: Salinity = 0.07 + (1.805 * chlorosity)

Legend

A Stewart's Canal
B Smithville Road
C Headwaters–Blackwater R.
D Footbridge–Blackwater R.
E. Buttons Creek
F Route 335–Blackwater R.
G Little Blackwater R.
H Shorters Wharf
I Bestpitch Ferry
J Fishing Bay



	A	B	C	D	E	F	G	H	I	J
Maximum	25.0	24.0	26.0	20.0	21.0	19.0	15.3	19.0	15.0	15.5
Minimum	1.7	1.0	0.0	0.0	0.0	0.0	0.0	1.1	0.1	4.5

Figure 3.5. Blackwater NWR salinity ranges A–J

The tides are asynchronous at the opposite ends of Blackwater River. A 4-hour tidal delay between the two connections to the Bay creates a pumping action that increases the salinity of the Blackwater River channels and swamps. According to salinity tests performed by the refuge staff, the freshest water is consistently found near the mouth of Buttons Creek (Glenn Carowan, personal communication 1997). A study conducted in June 1931 found that

most of Blackwater River was brackish, but that salinity decreased to the northwest in the vicinity of Little Blackwater River (Uhler and Nelson 1931).

Salinity monitoring during the Pendleton and Stevenson (1983:74) study indicated that salinity rates fluctuate seasonally. During a winter with high freshwater runoff, the entire river system within the refuge was essentially fresh. Salinity trends are also associated with climatic episodes, particularly storm surges and runoff fluctuations. Storm tides can flood refuge wetland areas with saltwater, which results in salt-saturated soils and tree mortality. Severe drought conditions, like those that occurred in 1997 and 1999, can also cause severe tree mortality, particularly in the transitional zones where forests meet marshlands.

Blackwater NWR Impoundments

Surface water on the refuge derives primarily from local precipitation. Blackwater NWR has a relatively large and efficient watershed, and receives substantial runoff from Green Brier, Kentuck, Gum, and Moneystump Swamps. Refuge impoundments are strategically located to intercept runoff from these swamps, which provide their primary source of freshwater. Refuge wells, all approximately 400 feet deep, can supply these systems with some moisture in drought emergencies, but their volume is insufficient for most moist soil management purposes and as sources for flooding in the fall.

Freshwater impoundments are located along Key Wallace Drive (Kentuck Swamp) and in Green Briar Swamp. These systems take advantage of the slight contour of the land, natural drainages, and the complicated and intricate anthropogenic drainage ditches that have been constructed over the millennia. Because of the flatness of the terrain, refuge staff must be constantly aware of the ability of these systems to flood important endangered species habitats and private lands if they are improperly managed.

The figures below (figure 3.6 and 3.7) indicate salinity trends at two locations on Blackwater NWR. The salinity data from 1944–1946 were derived from chlorosity (g Cl- / L) using this formula: Salinity = 0.07 + (1.805 * chlorosity).

1

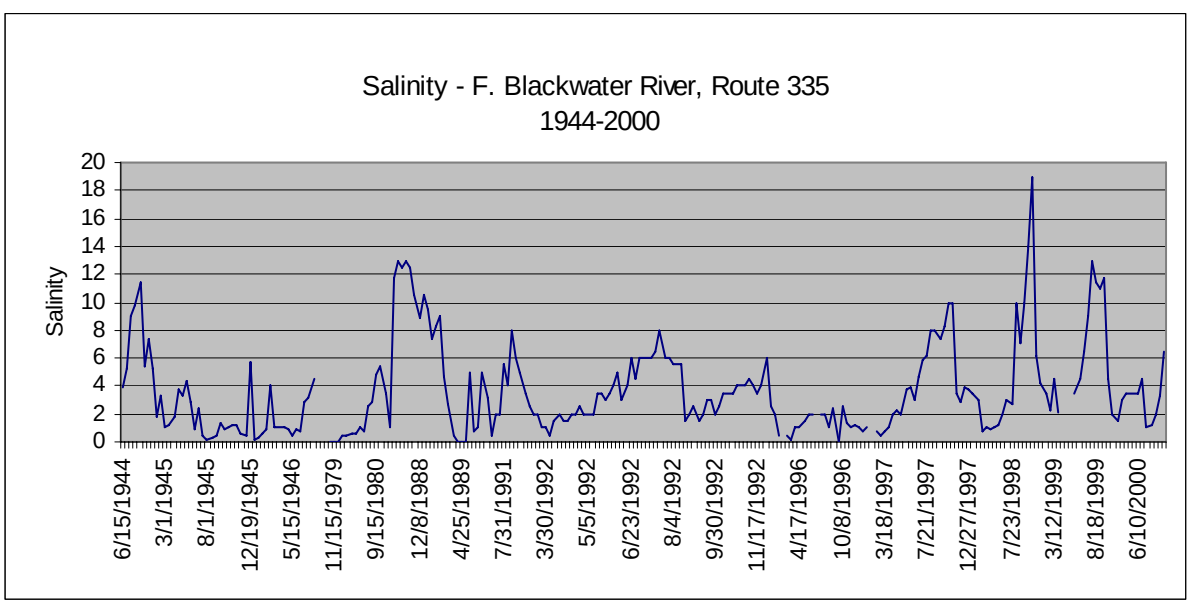


Figure 3.6. Salinity at Route 335

As the rising sea encroached farther onto the low-lying coastal plain, conditions became favorable for the establishment of tidal marshes in the lower Chesapeake Bay, including Blackwater NWR. Continued sea-level rise, coupled with accumulation of organic peats, drove vertical marsh growth and lateral marsh expansion. The exact sequence and timing of the transition of the Blackwater River from nontidal freshwater to tidal freshwater has not been established, but based on dates for this peat layer it began ca. 4000 B.P. (Rizzo 1995). Periods of marsh drowning or marsh emergence were likely to have occurred (e.g. Nydick et al. 1995), but at present, the Chesapeake Bay sea-level rise curves are not high enough in resolution to reveal such dynamics.

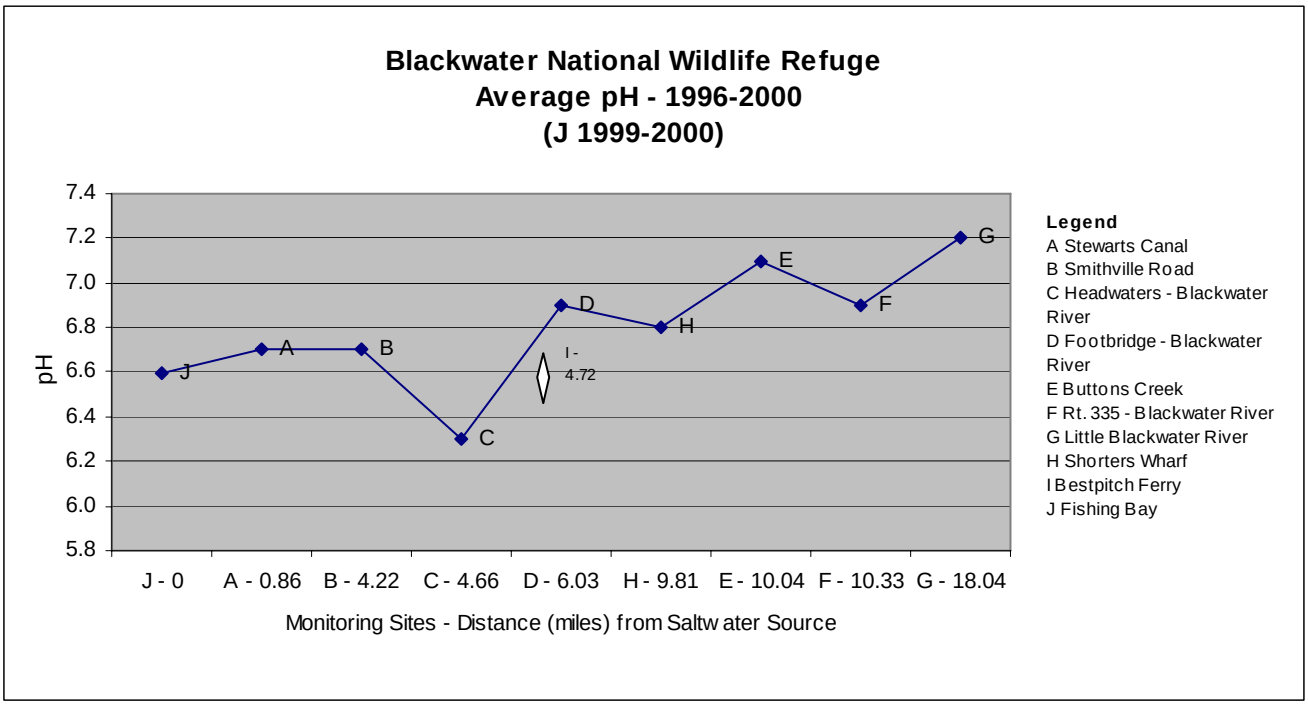


Figure 3.7. Average pH (Blackwater NWR)

Modern Marsh Loss and Sea-level Rise

Marsh loss is a major concern for the refuge; approximately 7,000 acres of marsh have been lost since 1940 through the formation and enlargement of interior ponds (Hester 1994:36; Leatherman et al. 1995; Pendelton and Stevenson 1983:15). This loss has been attributed to a hypothesized increased rate of relative sea-level rise this century and decreased sediment input to the system (Pendleton and Stevenson 1983; Rizzo 1995). However, the existing research and theories on the status of Blackwater NWR marshes contain some flaws.

One problem is that the timing and degree of the hypothesized (perhaps anthropogenically induced) increased inundation rate remain uncertain because sea-level rise estimates from scientific methodologies at dramatically different time scales (e.g., tide records versus stratigraphic reconstructions) may not be directly comparable. Frequently cited high estimates of modern relative sea-level rise are based on short tidal gage records, such as those from stations around Chesapeake Bay, including Baltimore, Annapolis, Solomons, and Washington, D.C.

From 1903 to 1980, the Baltimore gage registered a relative sea-level rise rate of 3.2 mm/yr, while from 1920 to 1983 the Annapolis gage registered a rate of 2.6 mm/yr (Braatz and Aubrey 1987; Hicks et al. 1983). Froomer (1980) reported a high relative sea-level rise rate of 2.74 mm/yr for Chesapeake Bay over the past 325 years based on stratigraphic and radiocarbon dating evidence.

Similarly, Nydick et al. (1995) used stratigraphic, radiocarbon, and foraminiferal evidence to obtain a high relative sea-level rise rate of 3.0 mm/yr for Connecticut marshes beginning in A.D. 1600. Thus, strong evidence indicates that any increased rate of sea-level rise began more than 300 years ago, before European settlement and the industrial

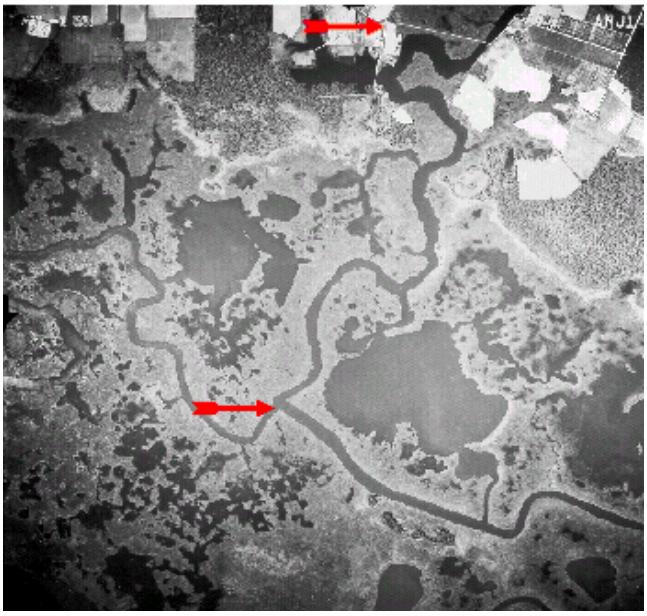


Figure 3.8. Comparative marsh 1938

revolution. In that case, the tidal marshes at Blackwater NWR have been able to keep up with accelerated sea-level rise until recently, suggesting that a different cause of marsh loss must be at work.

Another problem with the assertion that tidal marshes at Blackwater NWR are being lost due to sea-level rise is that tidal marshes in nearby Monie Bay (southeast of Blackwater NWR at the mouth of the Wicomico River) show no significant marsh loss or deterioration. Ward, et al. (1988) studied Monie Bay and reported "unlike the lower Nanticoke area, the marshes at Monie Bay show little evidence of increases in open water or other major signs of marsh deterioration despite the low accretion rates." They found that the average rate of marsh accretion at Monie Bay over the last 200 years was 3.0 mm/yr, with a range of 1.5–6.3 mm/yr. This rate is statistically indistinguishable from the long-term accretion rate of 3.6 mm/yr reported for Blackwater NWR by Rizzo (1995). Thus, none of the regional or global components of relative sea-level rise for Chesapeake Bay that play a role in marsh accretion can be responsible for localized marsh loss at Blackwater NWR.

Recent studies of coastal mangrove swamp loss in southwestern Florida (Tedesco and Wanless 1997) and salt marshes in North Carolina (Robert Young, personal communication 1998) demonstrate that while accelerated sea-level rise represents a stress on the coastal system, it takes a major disturbance, such as a series of hurricanes or a major coastal forest fire, to stop the coastal system from growing and allow inundation to result in terminal drowning. Also, where such disturbances occur over a large area, the system is unable to flush out the massive amounts of decaying organic matter, thereby inhibiting regeneration of the ecosystem in time to stave off inundation (Tedesco and Wanless 1997). At Blackwater NWR, several major stresses, including hurricanes, waterfowl population bursts, wildlife infestations, human interference, and groundwater withdrawals (Glenn Carowan, personal communication 1997) correspond with the recent period of patchy, rapid death of the marsh ecosystem reported by Rizzo (1995).

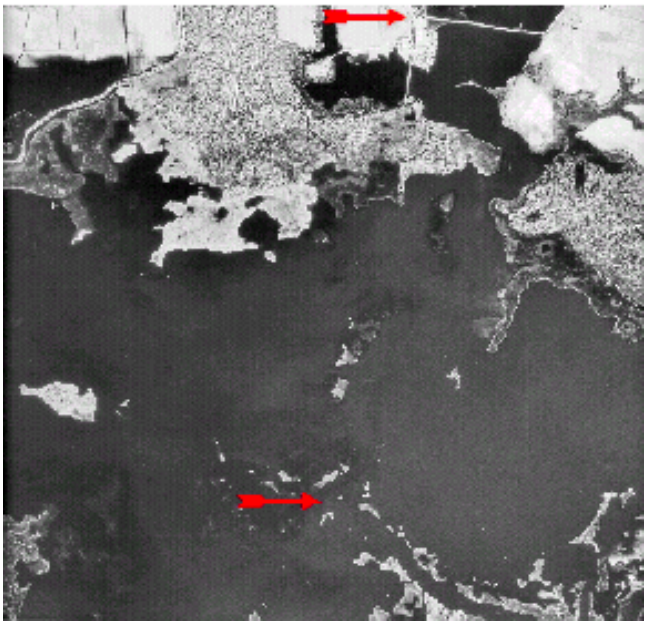


Figure 3.9. Comparative marsh 1989

Pendleton and Stevenson (1983) investigated the potential impacts of marsh plant production, grazing by overwintering Canada and snow geese, muskrats, and nutria, prescribed annual marsh burning, salinity, herbicides, rising sea levels, and effects of Maple Dam Road on marsh loss at Blackwater NWR. While they concluded that sea level is the dominant factor, their study does not address the ecological impacts of major hurricanes. Refuge Manager Carowan reports the surface muck present where Blackwater NWR marshes have been drowned has the consistency of chocolate pudding, which is virtually the same description used to characterize the surface muck in rotting, hurricane-destroyed mangrove swamps of Florida.[5]

Based on the more recent work illuminating the role of major disturbances in Atlantic coast and Gulf coast marsh inundation, an alternate hypothesis can be forwarded for

[5]Lenore Tedesco, personal communication 1997

the cause of marsh loss at Blackwater NWR. The three key elements of the hypothesis are (1) major disturbances destroy patches of vegetation and induce peat decay, (2) low tidal flushing inhibits ecosystem recovery, and (3) inundation is caused by enhanced subsidence of decaying substrates along with sea-level rise.

Pendleton and Stevenson (1983) report that 99 percent of total suspended solids flushing out by Shorters Wharf is from intertidal and subtidal (i.e., open water) sources. Furthermore, they state that Shorters Wharf Road (also called Maple Dam Road) inhibits inflow of fresh sediment during storms. These findings suggest that the system is attempting to flush out the decaying substrates, but the sediment-damming effect of the road is limiting this natural process. Without complete flushing of the decayed matter and eventual replacement by new inorganic substrates, it is unlikely that the marsh ecosystem will be able to recover. Further sea-level rise will continue the trend of marsh loss as long as the effects of past disturbances are not mitigated.

Chesapeake Island Refuges.—The effects of the changing hydrology of the Chesapeake Bay are best exemplified by an examination of the Island Refuges. These areas are artifacts of the changing course of the Susquehanna River. They have been substantially reduced in size, or even drowned, and sharp decreases in land area led to widespread abandonment of settlements on many of these areas in the first decades of this century. Rising sea levels caused progressive erosion, submergence, or both, eventually eliminating habitats and habitation. Under the present scenario of sea-level rise, this group of lands has a limited future without mitigation.

Nanticoke Protection Area.—The Nanticoke River drains the heart of the Delmarva Peninsula, including the southwestern third of Delaware and more than 100,000 acres at the center of Maryland's Eastern Shore. Countless small headwater streams channel water from coastal plain fields and forests into the upper reaches of the few major tributaries of the Nanticoke: Deep Creek and Broad Creek in Delaware and Marshyhope Creek in Maryland. In Delaware, the main stem of the river winds a meandering path above Seaford, with dense riparian forest overhanging the river. The tidal influence extends just north of Middleford, Delaware along the main stem; Federalsburg on the Marshyhope; the Laurel spillway on Broad Creek; and the Concord dam on Deep Creek, ultimately widening even further into a brackish bay just above its mouth at the Chesapeake Bay.

In an article published in "The Sun," titled "A Family for All Seasons," Mr. Tom Horton writes "From around Vienna, where the Nanticoke leaves its wooded swamps and turns from fresh to brackish, it sashays for 15 miles in a series of great bends and straights to around Tyaskin, where its riverine nature broadens into a sub-estuary of Tangier Sound and the Chesapeake. In this middle distance, along the Wicomico shore, each curve of the river embraces vast marshes, run through by hundreds of miles of 'cricks', 'guts', sloughs, 'dreens', ditches, canals, inlets, thoroughfares and assorted drainageways."

Near its mouth, the Nanticoke River merges with the Blackwater River from the west, forming a vast area of tidal marsh and shallow open water habitats known as "Fishing Bay" and "Tangier Sound." Because its tidal waters extend well upriver into Delaware, the Nanticoke River is navigable by large vessels (primarily tugs and barges) up to Seaford. Depths range from 35–40 feet at the mouth to approximately 10 feet at Seaford. Portions of the river are periodically dredged to ensure navigability. Currents in the lower tidal reaches vary in direction and strength with the tidal stage. The upper nontidal portion of the river has a consistent downstream flow typical of coastal plain rivers.

The Nanticoke is extensively bordered by wetlands, and damaging floods are rare, with little if any flood damage reported. At the mouth of the river, where it forms a brackish estuary, water salinity is highest in the fall (15–20 ppt) and lowest in the spring (10–15 ppt.; EPA 1989). The freshwater boundary (i.e., where salinity drops below 0.05%) migrates north and south in a predictable seasonal pattern, typically extending down the river in late winter or spring when the freshwater flow is highest, and up the river in late summer when downstream freshwater flow is lowest.

The limited data available from sampling in the river itself suggests that overall water quality in the Nanticoke River is fair to poor, with levels of nutrients and other chemicals reflecting the agriculture-dominated landscape of the Delmarva peninsula (Hamilton and Shedlock 1992). However, the river does not support its designated uses in Delaware, due to high levels of nutrients and fecal coliform bacteria (DNREC 1996). In 1996, researchers from Salisbury State University and the Nanticoke Watershed Alliance began a long-term study to monitor water quality

of the river. The Maryland Biological Stream Survey program published a comprehensive report in December 1997 that includes water quality data for the Nanticoke River and Marshyhope Creek.

Beds of SAV in the lower Nanticoke, like vast expanses of SAV's in the Chesapeake Bay, were decimated by water pollution and excessive sedimentation prior to the late 1970's (Kearney et al. 1988, Orth et al. 1993). The upper Nanticoke basin is known to support the largest tidal-freshwater SAV beds in Delaware (DNREC 1996). Significant portions of the upper tributaries of the river (particularly in Delaware) have been channeled to provide for agricultural drainage. Typically, the stream channel is cleared of vegetation on both sides of the stream, and the stream bed is straightened and deepened by bucket dredge.

Initial channeling in the past has been funded by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) with maintenance dredging left to tax ditch associations made up of landowners adjacent to the streams. Side ditches are generally dug in the surrounding agricultural lands to feed into the tax ditches. Channeling the upper reaches of the river is thought to have significant impacts on the hydrology and water quality of its main stem.

Agricultural ditching has changed the characteristic flow and timing of discharge of runoff from the watershed into the main stem river. This rapid discharge of runoff limits the ability of the stream and surrounding wetlands to remove nutrients and sediments coming off the uplands, and may substantially alter the seedbed conditions that provide for the germination and establishment of wetland vegetation. In addition, the deepening and straightening of small stream channels and the more rapid discharge of water from the minor tributaries has impacted both the areal extent and the characteristics of the headwater and palustrine nontidal wetlands in these areas.

Water is withdrawn from the river by both industrial and agricultural interests. Industrial uses are locally significant, but infrequent. The Delmarva Power & Light Company power plant in Vienna and the E.I. DuPont de Nemours nylon plant in Seaford are two principal water users. The total volume of water withdrawn by these and other industries, and the proportion of that water consumed, i.e., not returned to the river, is currently unknown. Similarly, an unknown number of farms withdraw water from the river. Although the total amount of water withdrawn for farming may be a much smaller volume than that taken for industrial uses, a significant proportion of irrigation water is lost from the local system, through evapotranspiration. At the same time, excess irrigation water pumped from deep aquifers but infiltrating into the ground after application may help artificially maintain surface flow in small streams and seasonal channels that otherwise would dry out during the summer when natural precipitation is low. Much more research is needed into the impact of irrigated agriculture on patterns of local groundwater flow.

Most, if not all, domestic needs and most agricultural water needs in the watershed are met by groundwater. Groundwater resources are reported to be abundant. Groundwater is available from wells in the unconfined water table aquifer up to 100 feet deep or deeper wells in the confined aquifers of the Choptank, Yorktown and Cohansey formations (Cushing et al. 1973; Andres 1994). Increased agricultural usage of the surface water aquifer for irrigation may cause localized groundwater supply problems affecting both natural communities and human needs, and this depletion process may be increasing over time (Brand and Huber 1997). Groundwater discharge is also a primary source of streamflow, supplying as much as 75 percent of the freshwater flow for the upper main stem Nanticoke and many of the tributaries (Johnston 1976; Staver and Brinsfield 1990).

Water quality is degraded in the surface aquifer on the Delmarva Peninsula as a whole because of contamination from agricultural activities in the watershed (Hamilton and Shedlock 1992; Staver and Brinsfield 1993). Nitrate concentrations are high from chemical fertilizers and from septic systems in areas with high populations. Pesticide levels in wells are also elevated in some areas. Excess nutrients and other chemicals in groundwater may take several decades to appear in local surface waters (creeks and streams), so the impacts of past land use activities can still be recorded today. Similarly, groundwater contamination due to current land use practices will persist long after evidence of those practices has disappeared from the landscape.

Modern Climate

Modern climatic conditions vary somewhat from the continental climate of the Coastal Plain. The influence of the Atlantic Ocean and the Bay gives the Eastern Shore generally milder winters, and summers with high humidity and relatively warm days and nights. Summer temperatures normally reach the upper 80's and occasionally climb into the 90's, although 102 °F has been recorded. The daily high temperature in July averages 87 °F. Winters are usually short, with an average daily low temperature in February of 26 °F. The watershed has a frost-free period of approximately 183 days.

From October through March, frequent high- and low-pressure systems alternate cold dry air from the north with warm humid air from the south. That pattern tends to break down in the summer, as warm moist air spreads northward from the south and southwest and remains over the area for much of the season. Intense low-pressure areas (hurricanes and northeasters) can bring torrential rains and winds of hurricane force to the Eastern Shore, especially during August, September, and October. Thunderstorms occur on about 28 days each year; most occur in July. Annual rainfall averages 43 inches. Of that, about 23 inches, or 53 percent, usually falls from April through September. The growing season for most crops falls within that period. The heaviest 1-day rainfall during that period was 7.00 inches, recorded at Vienna on September 27, 1985. Normally, August is the wettest month, and October the driest.

At Blackwater NWR, the lowest annual precipitation was 28.21 inches, recorded in 1942. The highest annual precipitation was 67.27 inches recorded in 1948. Average snowfall is 15 inches, and has ranged from 2 inches in the 1948-49 winter to 37.5 inches in the 1966–67 winter season. The heaviest 1-day snowfall in the past 40 years was 19 inches recorded on February 19, 1979. The average relative humidity in mid-afternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 74 percent. The sun shines 63 percent of the time in summer and 47 percent in winter. The prevailing wind is from the south. Average wind speed is highest, 11.0 miles per hour, in March.

Under the Clean Air Act, Dorchester County is classified as a Class II area, with air quality that is generally good. Dorchester County meets the National Ambient Air Quality Standards for emissions. Visibility in the county is good, generally averaging 3 to 5 miles. Facilities within the county that could be sensitive to smoke include Dorchester General Hospital, 9 miles from the refuge; City of Cambridge, 8 miles; Dorchester Airport, 8 miles; and Eastern Shore Hospital Center, 8.5 miles. All of these facilities are north of Blackwater NWR and Fishing Bay WMA, where marsh burning has been used as a management tool in the past.

Contaminants

The Chesapeake Bay Program has published “Targeting Toxics: A Characterization Report” that consolidates data previously collected by various groups, including Federal and state agencies, research institutions, and Bay Program-funded monitoring activities. The information is provided for 27 tidal rivers, including the Blackwater and Nanticoke rivers and their tributaries.

While most of the study area has a low probability for adverse effects from contaminants, field tests from 1984 to 1988 revealed a high larval mortality in striped bass in the Nanticoke River. Comparison tests between the Nanticoke and several rivers in Virginia in 1989, demonstrated that mortality of larvae was highest in the Nanticoke River. In fact, all larvae died in 8 of the 12 tests conducted on the Nanticoke. In contrast, survival ranged from 62 percent to 67 percent in 7 of the 8 tests conducted in Virginia rivers. Concentrations of lead, cadmium, chromium, nickel, arsenic, and selenium were consistently higher in the Nanticoke River.

Wetland Communities

Intertidal Wetlands

Table 3. 4. Acres of wetland habitat types

National Wetlands Inventory Subsystem	*Blackwater NWR*	*Barren Island*	*Bishop's Head and Spring Island*	*Martin NWR and Watts Island*	*Nanticoke Protection Area*	*Honga Focus Area*	*Subsystem Subtotals*
Estuarine intertidal	9,761.8	108.7	616.4	4,676.2	6,003.3	22,820.4	43,986.8
Estuarine subtidal	5,354.1	1.2	17.4	2,852.8	2,963.0	2,841.7	14,030.2
Lacustrine littoral	68.8	0.0	0.0	0.0	0.0	0.0	68.8
Palustrine wetland	5,007.5	42.7	6.4	0.0	5,613.9	13,523.8	24,194.3
Riverine tidal	0.0	0.0	0.0	0.0	268.0	0.0	268.0
Wetlands subtotals	20,192.2	152.6	640.2	7,529.0	14,848.2	39,185.9	82,548.1
Upland components	1,259.9	11.4	1.4	35.0	9,203.3	6,879.1	17,390.1
Totals	**21,452.1**	**164.0**	**641.6**	**7,564.0**	**24,051.5**	**46,065.0**	**99,938.2**

Source: USFWS, Delaware Bay Estuary Program Office, "GAP-enhanced" NWI data
Note: CCP boundary was used for Blackwater NWI acres

The Intertidal Wetland Community represents one of the most important and dominant components of the Blackwater–Nanticoke system and the study area, comprising almost 80,000 acres and making up one-third of all the tidal wetlands in Maryland. Almost all of the tidal wetland communities found in the Chesapeake Bay, except for the saline high and low marshes, can be found in this extremely diverse watershed. The intertidal wetland community includes six different categories:

1. Open Water, mudflat, sandbar/beach, and SAV beds;
2. Brackish Low Marsh;
3. Brackish High Marsh;
4. Freshwater Intertidal Marsh;
5. Freshwater Intertidal Swamp Forest; and
6. Freshwater Intertidal Shrub Swamp.

Each type is described in more detail below, and rare species found in this community type are listed in each respective community table. The intertidal wetland classification is based on community descriptions used by McCormick and Somes (1982). It should also be noted that these community descriptions apply to the entire study area, and not just to the strict confines of the Blackwater and Nanticoke rivers watershed. The non-tidal community classification is based on Cowardin's (1979) classification. The upland community descriptions are taken from Maryland Heritage information.

Open water, mudflats, sandbar–beach, and SAV habitats are found throughout the intertidal zone, and occupy more than 8,000 acres of the study area. The most important open water habitats are the large expanses of open water less than 5 feet deep. These shallow water areas occur primarily along the edge of the lower Nanticoke and

Blackwater rivers, the upper part of Fishing Bay, shallow water areas and beaches surrounding the islands, and the embayments in the brackish low and high marsh communities, like those on Blackwater NWR.

SAV, historically, has dominated these habitats, and even though SAV abundance has dropped 66 percent in the Chesapeake Bay since the late 1960's, some good stands of sago pondweed, widgeon grass, eelgrass, and horned pondweed still can be found in the Nanticoke system. It should be noted, however, that only small amounts of SAV can be found in the Blackwater system, due to degraded water quality and turbidity associated with marsh loss and erosion.

Table 3.5. Martin NWR SAV

Acres of SAV	*Tier 1*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*Reduction*
Back Cove2	508	469	474	480	444	351	307	40%
Big Thorofare	1427	1223	1348	1355	1342	1193	610	57%
Fog Point Cove	82	70	66	98	89	31	42	49%
Rhodes Point	337	286	341	333	336	54	27	92%
Terrapin Sand	1013	841	854	846	791	658	667	34%
Tylerton	422	338	404	409	320	101	94	78%
Total	**3789**	**3227**	**3487**	**3521**	**3322**	**2389**	**1747**	**52%**

The Chesapeake Island Refuges are the most productive area for SAV in the Chesapeake Bay, and Martin NWR is the most productive area for SAV in the Refuge Complex. Eel grass (*Zostera marina*) and wigeon grass (*Ruppia maritima*) are the dominant species, with wigeon grass occurring in waters generally less than 3 ft. deep MLW, and eel grass occurring in waters greater than 3 ft. MLW, but still within the photic zone. These grass beds are an important ecological component of the estuary. They provide food and cover for juvenile fishes, molting blue crabs, and many other crustaceans and mollusks, and are an important food for many species of waterfowl. It has been estimated that one square yard of SAV provides habitat for a minimum of 50 juvenile crabs. Assuming a 10-percent survival rate, each acre of SAV would produce approximately 24,000 individuals, or 160 bushels of marketable crabs per year. The beds also support a locally based crab scrape (soft-shell crab) fishery on Smith Island. The distribution of SAV in and around Martin NWR is shown below.

Intertidal mud flats are highly important as foraging areas for waterfowl, sport and commercial fishes, and many other species of food web value in the marine ecosystem. The mud flats along the upper tidal creeks and rivers are a unique ecotonal habitat that supports several rare plant species, including subulate arrowhead (*Sagittaria subulata*), and river bark quillwort (*Isoetes riparia*). The sandbar and beach habitats at the mouth of the Nanticoke River and on the Chesapeake Island Refuges provide foraging areas and nesting habitat. These areas are particularly important to certain species of shorebirds.

Brackish low marshes are characterized by only one wetland type: the smooth cordgrass (*Spartina alterniflora*). These brackish low marshes are extensive, covering about 16,000 acres and representing about 19 percent of all tidal wetlands in the study area. Because they are lower in elevation than the other brackish marshes, the low marsh is partly or wholly inundated during most periods of high tide. Smooth cordgrass marshes are found primarily on the Chesapeake Island Refuges of the Refuge Complex.

Brackish high marshes are by far the largest category of intertidal wetland in the watershed, and cover almost 50,000 acres in the study area. These marshes compose more than 80 percent of the intertidal wetlands and approximately 50 percent of the Blackwater and Nanticoke rivers watershed in Maryland. It is also a very diverse category with nine different wetland types. These wetland types tend to occur in nearly monotypic stands. In order of abundance, they include needlerush, threesquare, meadow cordgrass, spikegrass, big cordgrass, cattail, marsh elder–groundsel bush, switch grass, common reed, and rose mallow. The open water and brackish intertidal communities do not have significant numbers of threatened or endangered species, except for the plant, elongated lobelia. These marshes are very common on Blackwater NWR and the Chesapeake Island Refuges.

The dominant plant community types in the brackish high marsh are needlerush (*Juncus roemerianus*) and threesquare (*Shoenoplectus spp.*). Each of these community types occupies about 20,000 acres of the study area, and

each represents about 18 percent of the total tidal wetlands. The Olney threesquare marshes are what have historically made Blackwater NWR world famous and the haven it has been to waterfowl for centuries. Olney threesquare (*Shoenoplectus americanus*) is the predominant species in the threesquare marshes, but common threesquare (*Scirpus americanus*) and stout bulrush (*Scirpus robustus*) may be more abundant in the landward sections of the marshes. Net aerial primary production of *Shoenoplectus americanus* at Blackwater NWR was found to average 639.4 grams of dry weight per square meter, which is in the middle of the range for Chesapeake Bay marshes (Pendleton and Stevenson 1983).

Within the study area, meadow cordgrass (*Spartina patens*) and spikegrass (*Distichlis spicata*) marshes occupy more than 10,000 acres of the study area (11.7 percent); big cordgrass (*Spartina cynosuroides*) occupies more than 4,000 acres (5.1 percent); and cattail (*Typha spp.*) occurs on approximately 2,000 acres (2.7 percent). Stands of big cordgrass tend to occur along the banks of the rivers, creeks and guts; the meadow cordgrass and spikegrass occupy the most saline areas; and cattail is found in the least saline areas.

Other wetland community types in the brackish high marsh category are those dominated by marsh elder (*Iva frutescens*), groundsel bush (*Baccharis halimifolia*), switch grass (*Panicun virgatum*), common reed (*Phragmites communis*), and rose mallow (*Hibiscus spp.*). The shrubby marsh elder–groundsel bush wetlands occupy sites along the upland margin of the wetlands on natural levees and turf banks. Unlike the other brackish high marsh plant communities, the marsh elder–groundsel bush and rose mallow do not occur in pure stands of the predominant species. In stands of marsh elder and groundsel bush, the undergrowth commonly is formed by meadow cordgrass. Rose mallow is commonly found with switch grass, Olney threesquare, narrowleaf cattail and smartweeds.

According to McCormick and Somes (1982), the average areal biomass production of brackish high marshes exceeds that of the low marsh. As with the low marsh, most of this biomass is used by consumers as detritus. The exception to this rule would be the use by some bird species of the seeds and roots of certain plants. The seeds of species such as the bulrushes and panicgrasses are important food sources tor waterfowl, shorebirds, and songbirds. The roots of *Scirpus* spp. are food for waterfowl, particularly Canada geese, muskrats, and nutria.

Freshwater intertidal marsh is one of the most important marsh types, based on total ecological value, and covers more than 5,600 acres in the study area. It is among the highest in wildlife productivity and waterfowl utility, and is closely associated with fish spawning and nursery grounds. This community is highly valued as a natural shoreline stabilizer and sediment trap for upland runoff. The 3-5 tons of plant biomass produced per acre each year is fully accessible to the estuary.

The predominant wetland types are cattail, pickerel-weed (*Pontederio cordata*), arrow arum (*Peltandra virginicum*), bulrush (*Scirpus* spp.), and spatterdock (*Nuphar advera*). These four types make up about 80 percent of the wetlands of this category. Other wetland types in this category include big cordgrass (*Spartina cynosuroides*), smartweed (*Polygonum spp.*), rice cutgrass (*Leersia oryzoides*), wildrice (*Zizania aquatica*), sweetflag (*Acorus calmus*), rose mallow (*Hibiscus* spp.) and common reed.

This habitat community also has at least two State-listed species, the spongy lophotocarpus (*Sagittaria calycina*), threatened, and the marsh wild senna (*Chamaecrista fasciculata*), endangered. The latter is also a candidate for Federal listing; the only known population in Maryland is the one at Mill Creek, in the Nanticoke protection area. Other rare plant species in this community include elongated lobelia (*Lobelia elongata*), and a beggars tick (*Bidens discoidea*). The large number of wetland types (10) in the freshwater marshes is a reflection of the tendency of marshes to increase in plant diversity with decreased salinity (Anderson, 1968; Gabriel and de la Cruz, 1974). Phragmites, an exotic species, is an aggressive colonizer and displaces many other marsh plant species in this community.

Freshwater intertidal swamp forests are contiguous with the freshwater intertidal marshes, and cover about 8,000 acres within the study area. These swamp forests are composed of red maple–ash (*Acer rubrum–Fraximus spp.*) swamp forests (called 'cripples' on the Nanticoke) and the loblolly pine swamp forest (found principally on the Blackwater). The deciduous swamp forests occur in the upper reaches of the main stem river and creeks on the Nanticoke River, and tend to merge almost imperceptibly into the inland palustrine swamp forest, as do the loblolly pine swamp forests of the Blackwater NWR. They are noticeably smaller than the palustrine forests of the same species, and tend to shed their leaves earlier.

The most extensive intertidal swamp forest in the watershed is the red maple–ash type, which covers about 7,000 acres (5.4 percent) of the study area, mostly within the Nanticoke protection area. Other trees within this broadleaf forest type include green ash (*Fraxinus pennsylvanica subintegerrima*), blackgum (*Nyssa sylvatica*), and sweetbay (*Magnolia virginiana*) (McCormick and Somes, 1982). The loblolly pine swamp forests occupy about 900 acres (1 percent) of the study area, and generally occur adjacent to brackish marshes. They may be either pure stands or mixed with broadleaf trees. Collins sedge, Mitchell's sedge, a beggars tick, and false hop sedge are rare plant species found in the freshwater intertidal swamps.

Freshwater intertidal shrub swamps are similar to the swamp forests in species composition, but represent an earlier stage of forest regrowth and may also be characterized by dogwood, poison ivy, black willow, smartweeds, royal fern and water hemp. The intertidal shrub swamp comprises about 897 acres (1.1 percent) of the watershed.

Riverine Wetland

Riverine systems are defined by Cowardin (1979) as areas in which moving water flows through a channel at least periodically and salinity is less than 0.5 ppt (parts per thousand). The boundaries of riverine wetlands are further defined as the area from the channel of non-tidal rivers and streams up to the channel bank or to wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens (Cowardin et al. 1979). Riverine wetlands make up a minor component of the total wetland complex within the watershed, and are restricted to a narrow band of wetlands along the upper reaches of the main stem of Marshyhope Creek and the Nanticoke River, and some of the Delaware tributaries. The upper Blackwater River historically could have been considered as riverine wetlands, but salinities are currently too high. The riverine wetlands are habitat for the rare subulate arrowhead (*Sagittaria subulata*) which colonizes the muddy banks.

Palustrine Wetland

A significant proportion of the land area of the Delmarva Peninsula is occupied by nontidal or palustrine wetland communities of one type or another. The sandy soils that characterize most of the lower Peninsula allow rapid draining of surface water, but the combination of low elevation and little or no relief and moderate annual precipitation produces a landscape that features large areas that have saturated soils or which hold standing water during several months of the year. These communities include forested swamps lining streams and rivers (floodplain forested swamps), extensive low swamp areas (nonfloodplain forested swamps) that may or may not drain into (or act as the headwaters for) small creeks and streams, seasonally flooded ponds ("Delmarva" or "Carolina" bays) with open or closed canopies, small bog habitats, open water millponds with bordering vegetated wetlands, and a number of other wetland types (natural and man-made) intermediate in character between these primary types.

Palustrine wetlands play a very important role in protecting the water quality of the Blackwater and Nanticoke river systems. These communities provide the basic "ecosystem services": filtering nutrients and chemicals from surface and groundwater, trapping excess sediments, and moderating floodwaters and storm effects. Floodplain forested swamps form a protective corridor that buffers streams and tributaries from both natural and anthropogenic impacts and disturbances. Similarly, forested wetlands at the headwaters of streams play a major role in determining both the amount of flow in the streams, and how clean that water will be.

Taken together, palustrine wetland communities in the watershed support a host of rare plant and animal species. This is especially true for habitats that are intrinsically rare on the Coastal Plain (e.g., bogs), as well as for those that have suffered dramatic reductions in abundance and distribution on the Delmarva Peninsula (e.g., seasonally flooded ponds) as a result of human activity. Palustrine forested wetlands also provide some of the best wildlife habitat in the watershed (and on the Peninsula). Because these woods have been much less disturbed than upland forests, they retain the structural and ecological characteristics that promote high species diversity and efficient ecosystem cycling.

Within the palustrine forested wetlands on Blackwater NWR, two existing "green tree reservoirs," totaling approximately 10 acres, are managed, monitored, and maintained to provide seasonal sources of flooded hard mast and macro invertebrates as food resources for migratory birds, principally wood ducks, black ducks, and mallards.

Drawdown occurs in early March to maintain living or "green" timber that will live year after year to produce hard and soft mast and detritus for macro invertebrate production. Reflooding occurs in late September or whenever there is sufficient rainfall. Water levels are monitored biweekly during the winter, and maintained in accordance with the Annual Water Management Program.

Most of the 40 types of palustrine communities described by the USFWS National Wetlands Inventory (NWI) are found in the Blackwater NWR and Nanticoke protection area. However, most of the NWI community types can be grouped into one of the following categories.

Floodplain Forested Swamps.—Floodplain forested swamps occur along many of the small creeks and larger streams. The forested swamps along the Marshyhope Creek are good examples of these habitats that are dominated by red maple, black gum, some scattered loblolly pine, and an understory of holly and sweet bay. Shrub cover within these types of forested swamps is dominated most often by sweet pepperbush and highbush blueberry, and can also include rhododendron, serviceberry, and fetterbush. Several different types of ferns are common in the herbaceous layer, as well as various species of sedges. On some floodplain terraces, ash, river birch, and oaks form part of the canopy.

Non–Floodplain Forested Swamps.—Non-floodplain forested swamps are forested swamps in closed basins or not closely associated with a flowing stream. While the plant composition is very similar to that of the Floodplain Forested Swamps, the canopy is often dominated by very large (2- to 3-foot DBH) and widely spaced red maples, with some sweet and black gums. These are "old growth" swamps.

One unique type of non-floodplain forested swamp is the Atlantic white cedar swamp found in the Nanticoke protection area. This community type is found above the intertidal swamp zone along rivers, as well as in palustrine wooded wetlands away from the rivers. In pure stands, Atlantic white cedar may occupy half of the canopy, with red maple, black gum, loblolly pine, and sweet gum making up the remainder.

Palustrine Forest on Blackwater NWR

Practically no virgin forests remain in Dorchester County. Almost all of the woodland in the county has been cut several times, much of which had been permanently cleared for agriculture, and to a lesser extent, development. Most of the remaining woodlands exist in small isolated patches surrounded by agricultural fields. Blackwater NWR currently contains some of the largest contiguous forests in Dorchester County, and has been identified as a major forested hub by the Maryland Green Infrastructure Program.

Table 3. 6. Forest cover types (Blackwater NWR)

Forest Type	*Acres*
Regeneration	1,270.26
Loblolly Pine	1,328.15
Loblolly Pine–Hardwood	2,958.11
Mixed Hardwoods	1,232.68
Stunted/Inoperable	1,458.18
Miscellaneous	98.63
Total†	**8,346.01**

†plus small islands in wooded compartments

The forested habitats that occur on Blackwater NWR are primarily palustrine forested wetlands and, to a lesser extent, forested uplands, estuarine intertidal forests, and palustrine scrub forests, as defined by National Wetlands Inventory Standards. The four major forest cover types delineated on Blackwater NWR are Loblolly Pine, in which loblolly pine comprises at least 80 percent of the basal area of the stand; Loblolly Pine–Oak, in which loblolly pine comprises 20–79 percent and oak species account for 20 percent or more of the basal area; Loblolly Pine–Mixed Hardwood, in which loblolly pine comprises 20–79 percent and hardwoods other than oak comprise at least 20 percent of the basal area of the stand; and Mixed Hardwoods, in which various hardwood species account for at least 80 percent of the stand (table 3.6; Whiteman and Onken 1994).

For the purpose of our CCP and our forest management plan, we have combined the Loblolly Pine–Oak type and the Loblolly Pine–Hardwood type into the "Loblolly Pine–Hardwood" type. Harvested or regenerating stands and planted sites containing trees up to 15 years of age are pooled to form the "Regeneration" cover type classification. Areas dominated by stunted and dying trees are combined with stands dominated by dead trees to form the "Stunted/Inoperable" cover type classification. The final subclassification of the forest habitat is referred to as "Miscellaneous Forests"; it includes all of the wooded islands scattered throughout the marsh and all of the narrow

wooded fringes that border ditches and small patches of trees (<2 acres) that are not part of any other forest habitat. Blackwater NWR now contains 8,374 acres of forested habitats.

The most dominant tree species on Blackwater NWR is loblolly pine (*Pinus taeda*). Well adapted to the Atlantic Coastal Plain of Maryland's Eastern Shore, loblolly pine grows well on soils with imperfect to poor surface drainage. It is shade-intolerant, so some form of disturbance is necessary to maintain the species. Most view the "climax" forest for the loblolly pine type as several possible combinations of hardwood species and loblolly pine. Some evidence indicates that, within the range of loblolly pine, several different tree species could potentially occupy a given area for an indefinite period of time, and that disturbance is a naturally occurring phenomenon. If this is so, then the climax for this forest might best be termed the "southern mixed hardwood–pine forest" (Baker and Langdon 1990).

The common hardwoods include sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), swamp chestnut oak (*Quercus michauxii*), willow oak (*Quercus phellos*), black oak (*Quercus velutina*), white oak (*Quercus alba*), American beech (*Fagus grandifolia*) and American holly (*Ilex opaca*). Shrub species found in association with these forest types include high bush blueberry (*Vaccinium corymbosum*), sweet pepper bush (*Clethra alnifolia*), maleberry (*Lyonia ligustrina*), swamp sweet bells (*Leucothoe racemosa*), poison ivy (*Toxicodendron radicans*), and various species of green briar (*Smilax spp.*).

Of all the hardwood species found, the most important are the oaks. Oaks are the life support system for many animals. Acorns are eaten by many species of birds and mammals, including deer, bear, squirrels, mice, rabbits, foxes, racoons, grackles, turkey, grouse, quail, bluejays, woodpeckers, and waterfowl. The population and health of wildlife often rise and fall with cyclic production of acorns. Acorns' importance to wildlife is related to several factors, including their widespread occurrence, palatability, nutritiousness, and availability during the critical fall and winter period (Johnson, 1994).

Due to the low elevation of much of the forested habitats and the underlying layers of impermeable clay in the soil horizon, it is not uncommon for entire forest tracts to be flooded throughout much of the winter and spring. Those areas characterized by longer periods of ponding or flooding tend to have extremely sparse understories and little to no regeneration.

Forest Communities

Loblolly Pine TNC Vegetation Classification Types

I.A.8.C.x.9 Pinus Taeda Planted Forest Alliance

I.A.8.N.b.16 Pinus Taeda Forest Alliance; Pinus taeda / Liquidambar styraciflua–Acer rubrum var. rubrum / Vaccinium stamineum Forest; Pinus taeda / Myrica cerifera / Vitis rotundifolia forest.

I.A.8.N.g.300 Pinus Taeda Saturated Forest Alliance

Pure loblolly pine stands occur throughout the refuge at all elevations, but often bordering marsh habitats. Pure pine stands not yet affected by rising sea levels comprise 1,328 acres (16 percent) of the total forest acres. Pine stands along marsh transition zones in general make up the stunted forest type, and comprise 1450 acres (17.4 percent) of the forest area. When loblolly pine predominates, it forms the Society of American Foresters Forest Type 81, Loblolly Pine (Baker and Langdon, 1990), and the following Nature Conservancy Forest Alliances: A. 30 Pinus Taeda Forest Alliance. In immature stands, the pines are generally very dense with a dense understory of various shrubs, grasses, and hardwood saplings. The understory in mature stands is usually more open, with wax myrtle, holly, grasses, and other hardwoods. These stands represent an early stage of succession; hardwoods dominate the sub-canopy and will eventually dominate the stand.

In general, loblolly pine begins to decline around age 80, and will be mostly eliminated from a stand by the age of 100 to 150 years (BRefuge 1984; Giese, Rider, Daniels, 2000). This occurs at an earlier age on wetter sites where trees become more stressed and susceptible to insect and disease outbreaks due to greater frequency and duration of

flooding. The primary cause of pine mortality in this region is red rot disease or heart decay caused by numerous species of fungi. Also associated with frequent flooding is the risk of salt water intrusion, which has affected many of the forested habitats on the refuge.

On the more upland sites, as loblolly pine declines, it will be replaced by dense stands of red maple and sweet gum with little to no oak component. Red maple (*Acer rubrum*) and sweet gum (*Liquidambar styraciflua*) are major components of all forest types present on the refuge, and are positioned to take advantage of any gaps in the canopy. Due to their faster growth rates and hardiness, they generally out-compete all other tree species, especially slower-growing oaks. Also on upland sited pure loblolly pine stands may occur as plantations or stands of natural origin that were managed for pine production early in there development. Near pure pine stands also exist as newly regenerating stands where woody shrubs are the pine's primary competition for nutrients. The understory within these stands can range from fairly sparse in mature stands to very dense in young or more open stands. Common understory species include *Smilax spp.,* wax myrtle, poison ivy, and switchgrass.

Loblolly pine–mixed hardwood TNC Vegetation Classification Types

I.B.2.N.d.16 Quercus (Michauxii, Pagoda, Shumardii)–Liquidambar Styraciflua Temporarily Flooded Forest Alliance, Pinus taeda–Quercus (michauxii, falcata) Liquidambar styraciflua temporarily flooded forest.

Pine–hardwood associations in this region represent a more intermediate stage of succession towards a climax hardwood forest. Loblolly pine is the dominant canopy species in this community type, with red maple, sweet gum, holly, and black gum dominating the sub-canopy. Various oak species as well as American beech also occur throughout most of these stands. The occurrence of specific species of oak or beech is directly related to micro topography, elevation, and soil moisture. Where willow oaks are most frequent on the lower elevations, the presence of beech indicates the highest and driest sites in the stand.

Upon reaching maturity, canopy closure eventually shades out intolerant young loblolly pine which is replaced by shade tolerant hardwoods such as oak and beech. As in the pure pine stand, heart rot will eventually succeed in removing pine from the upper canopy as well. On these marginally drier sites, loblolly pine may live to 120 to 150 years. However, growth rates, mast production, and overall health begin to decline dramatically between 80 and 100 years. Increment cores from several 120-year-old loblolly pines revealed negligible growth for almost the last 20 years. Again, the gaps created in the canopy will most likely be filled by maple and gum. Oaks and beech will persist in the sub-canopy inching their way to dominance and, eventually, the climax species of the stand.

Selective thinning of red maple and sweet gum to release oaks at an early stage of succession would ensure a greater prevalence of oaks in the canopy. Then as gaps are created, the oaks would be the first to capitalize by expanding their crowns. Wider crowns result in higher rates of photosynthesis, growth rates and ultimately mast production. Perpetuating oak survivability versus red maple or sweet gum would greatly enhance Delmarva fox squirrel habitats.

Mixed Hardwoods TNC Vegetation Classification Types

I.B.2.N.a.22 Liquidambar Styraciflua Forest Alliance

I.B.2.N.d.16 Quercus (Michauxii, Pagoda, Shumardii)–Liquidambar Styraciflua Temporarily Flooded Forest Alliance

I.B.2.N.e.6 Liquidambar Styraciflua–(Acer Rubrum) Seasonally Flooded Forest Alliance

I.B.2.N.e.15 Quercus Phellos Seasonally Flooded Forest Alliance

I.B.2.N.g.2 Acer Rubrum–Nyssa Sylvatica Saturated Forest Alliance

Natural, pure hardwood stands are limited to narrow bands along low wet drainage ways. However, mixed hardwood stands occur throughout Blackwater NWR as a result of various anthropogenic forces. Hardwood fringes

border agricultural lands and ditch banks, and serve as wooded corridors that connect otherwise fragmented habitat. Green tree reservoirs exist adjacent to seasonally flooded moist soil units, and provide an invertebrate food source for wintering waterfowl. The most dramatic force resultant in mixed hardwood forest types was the selective removal of more valuable pine from pine–hardwood stands, also known as high grading.

The residual stands created by this harvest method are generally characterized by having an over-mature canopy of poor quality hardwoods, little to no mid-story, and dense shrub understory. The remnant hardwoods, especially oaks, tend to be stunted and stressed from being suppressed their entire life by overtopping pines; therefore they are more susceptible to forest insect pests and disease. On rare occasions, high graded stands flourished as mature oak dominated stands of good health and quality. The remnant trees were vigorous enough to take advantage of the release, and increased crown diameter to fill in the gaps and maintain a sparse understory. Several factors may have caused such a dramatic contrast in tree response such as time of harvest, soil type, hydrology, and percentage of overstory removed.

Stunted/Inoperable TNC Vegetation Classification Type

I.A.8.N.g.300 Pinus Taeda Saturated Forest Alliance

These stands are generally portions of loblolly pine stands that border marsh habitats and grow on Sunken soils. The potential productivity is low for loblolly pine on Sunken soils. Because of the sodium salts in the upper layers of the soils, the trees are stunted and seedling mortality rates are increased (USDA 1998). Therefore, these stands are dominated by stunted, mature loblolly pine of small diameter and height. The understory consists primarily of grasses and sedges along with wax myrtle and green briar. Due to rising sea levels, these stands are inundated for several months of the year by tidal waters, during which they are exposed to varying concentrations of salt which causes the stunting and ultimately widespread mortality and conversion to marsh.

Most of these stunted pine stands buffer estuarine tidal wetlands and are protected by the Critical Areas Commission, and in some cases Natural Heritage Area designations. Please consult the Forest Management Plan for a more thorough description of the forest classifications and types in each refuge compartment.

Coastal Plain Ponds (Delmarva Bays) – Among the most unique wetland habitats in the study area are the seasonally flooded ponds known as “Delmarva bays.” These wetlands fill with water in the winter as ground water levels increase, then gradually dry in July and August. The plant species are specially adapted to these fluctuating conditions. Many of these areas have been drained and converted to agricultural lands, timber plantations, or residential development, and for this reason these wetlands and their dependent species are quite rare in Maryland, Delaware, and regionally. The Coastal Plain Ponds contain some of the rarest species in the study area, and accordingly have been the focus of conservation efforts by many agencies and conservation organizations.

Open Canopy Herbaceous Wetlands

Open Water Habitats (Ponds and Impoundments) – On the Delmarva Peninsula, conditions that support an open water habitat with a constant freshwater inflow and outflow are restricted primarily to man-made ponds. Sand and gravel “borrow” pits and old millponds along the Nanticoke River, created by damming small streams many years ago to provide water power for mills, provide excellent habitats for spatterdock, waterlily, bladderwort, pink bog-bottom, bur-reed, St. John's wort, buttonbush, and water hemlock.

Twenty-four freshwater ponds, the largest being 6 acres, have been created by refuge staff or previous landowners on Blackwater NWR. These ponds are maintained and managed to support wildlife and a diversity of plant and animal life, and most importantly serve as a source of fresh water to supply nearby moist soil units. Two of these ponds are equipped with dry hydrants to supply emergency sources of water during wildland suppression fire operations. Periodic dredging to maintain pond depth, and mechanical or chemical control to treat woody vegetation and other invading species is performed as necessary.

These fresh water impoundments, totaling 368 acres, are managed and maintained on Blackwater NWR principally to provide food and habitat for migratory birds (waterfowl, shorebirds, and wading birds). Most of the existing

impoundments have been constructed on "prior converted or farmed wetlands." A management technique, known as "moist soil management," is the current management practice in these impoundments.

When implementing moist soil management, pool drawdowns typically occur between mid-March and early June, depending on the wildlife objectives and moist soil plant/invertebrate response desired. Drawdown is initiated in most pools first by gravity flow, but pumping is often required in most of the impoundments to remove all the water. Several permanent and seasonal pumping stations, utilizing gasoline, diesel, and electric pumps, are operated and maintained. Rates of drawdown are critical, and, depending on the pool bottom topography and soil type or organic content, can occur rapidly or must be prolonged. All drawdowns are completed by mid-June, and pool bottoms are maintained as moist as weather conditions will allow to facilitate the germination, growth, and production of a wide diversity of emergent moist soil plants such as smartweeds, beggartick, red-root cyperus, Panicum, Walters' and barnyard millets, dwarfed spike rush, etc.

Water levels, pH, conductivity, and salinity are monitored and recorded weekly during the growing season and biweekly during periods of flooding. Exact water level management plans are described in an Annual Water Management Program, and used as an annual management guide (rainfall dependent). Vegetative transects are conducted between mid-June and mid-July, and again in early September, to determine success or failure of vegetative response. When preferred emergent vegetation has failed to grow and weeds like cocklebur and fleabane are dominant, these areas are disced and a small grain crop, such as millet or sorghum, is planted. Gradual reflooding begins in September, depending on having the necessary fresh water which is supplied through rainfall, snow melt, runoff through Kentuck and Green Briar Swamps, adjacent freshwater ponds, or by a limited number of small wells.

The waters of the Blackwater and Little Blackwater Rivers and the adjacent marshes (once fresh and used for these purposes) are currently too salty for this use. When used for flooding in the past, waters from these sources have significantly contributed to increased soil salinity (and subsequent soil sterilization) in several impoundments, particularly sub-impoundment 5b. Runoff can be significant at times (particularly during hurricanes and tropical storms) from adjoining private land in Kentuck and Green Briar Swamps. This is particularly true for the lands adjacent to impoundments 3 and 5, which are separated from Kentuck Swamp by Key Wallace Drive, and it is not uncommon to observe water sheeting across 2 miles of Key Wallace Drive and several places along State Route 335 after major weather events. Appropriate consideration must, therefore, always be given to ensure that dikes and water control structures are properly constructed, sized, and maintained so as not to inadvertently result in flooding private lands.

Because of the flat topography of most of the refuge, many opportunities are lost to create additional impoundments or maintain water reserves since the presence of supporting impoundment infrastructures can severely restrict historical drainage patterns and create flooding of private lands. Periodic disturbance, mowing and discing, are utilized to destroy monicultures and set back succession. Moist soil wetlands that are normally dominated by seed-producing annuals, may shift to less desirable perennials after several years and need to be rejuvenated. Undesirable plants that have little or no wildlife value need to be controlled so that they do not outcompete plants with greater values. When manipulation is required, it is timed so that the resultant decomposing vegetation can be used effectively by wetland invertebrates.

Manipulation of managed wetland areas is often better described as a learned craft or art, rather than strictly as applied science. Each impoundment and subimpoundment has its own unique characteristics, and preliminary assessments include the following considerations when managing these wetlands.

1. Site location to assess salinity and pH;

2. Determination of topography to better understand subtle elevational differences within specific managed wetland sites and to better predict vegetational responses to disturbances and water regimes;

3. Maintaining systematic records of water level changes to assess vegetation response and determine availability of optimum foraging depths (also included will be a monitoring program to record amounts of water from the flooding sources);

4. Monitoring water quality;

5. Site inspections and monitoring to evaluate site use and to identify manipulations needed to enhance or prevent certain vegetative conditions;

6. Plant identification to ensure proper timing and type of manipulation;

7. Effects of burrowing animals to maintain integrity of levees and dikes;

8. Equipment capabilities, availability, and readiness will be determined; and finally

9. Critical time periods will be identified for implementing preferred management strategies (Fredrickson and Reid, 1988).

Coastal Plain Bogs.—True bogs are most common in the mountain region of western Maryland, but several important examples of bog communities occur in the watershed, principally along the Nanticoke River. Because they are somewhat different than the true bogs of western Maryland, they are referred to here as "Coastal Plain bogs." These habitats are relatively rare on the Eastern Shore, and most that do exist are the result of human modification of the environment. Old millponds that have been dammed for many years or stream areas crossed by power lines have accumulation of peat and herbaceous plants. These areas are often colonized by carnivorous plants and other rare plant species.

Wet Meadows.—Another artificial open canopy herbaceous wetland community type located on Blackwater NWR and within the Nanticoke protection area is wet meadows. Many wet meadow habitats were created as a result of power transmission line construction, which removed the tree canopy from areas that were formally forested wetlands. Several wet meadows are maintained at Blackwater NWR (e.g. Stanley and Slacum Fields).

The alteration, disturbance, degradation, dredging, or filling of these freshwater wetlands, most particularly those activities affecting naturally occurring wetland systems, are closely regulated by local, State, and Federal agencies. Management actions designed to convert one freshwater wetland type to another are regulated by the U.S. Army Corps of Engineers and discouraged by the Service (excluding actions to convert "prior converted wetlands" to more functional wetland systems). For example, conversion of a naturally occurring inland palustrine forested wetland to a green tree reservoir, where water levels are regulated and controlled flooding is practiced during the winter months, is not permitted by the regulatory agencies. Similarly, actions that alter the existing hydrology in such a way as to convert palustrine wetland communities to freshwater swamps also are regulated, and not permitted. While protecting wetlands from loss and degradation, today's strict laws have precluded many types of wetland restoration and enhancement actions, and limited these activities to the following.

1. Control of noxious and invasive weeds in both man-made and naturally occurring freshwater areas;

2. Restoration or conversion of "prior converted wetlands" and uplands to freshwater systems, principally shallow and deep water ponds, impounded wetlands, inland palustrine forests, and wet meadows;

3. Management or restoration of these man-made ponds, millponds, impoundments, inland palustrine forests, and existing green tree reservoirs; and

4. Silvicultural management of forests in inland palustrine forested wetlands.

Therefore, these activities must be sensitive to two very important needs. First, wetland losses must be avoided wherever possible, and unavoidable losses must be compensated to ensure that "no-net-loss" of wetlands is maintained. Second, wildlife managers must achieve their objectives with minimum adverse impacts on wetland values and functions. A major issue discussed during the scoping process was to what extent "prior converted wetlands" will be maintained in agriculture or restored or converted to one of the freshwater systems mentioned above. This issue is specifically addressed in Chapter4, Management Direction.

Upland Communities

Xeric Dunes.—The ancient xeric dunes are dry sandy ridges formed 13,000 to 30,000 years ago out of the underlying Parsonsburg Sand formation. This geologic strata is particularly well developed along the east side of the Nanticoke River in both Maryland and Delaware, and ranges in height from 3 to 12 meters. Where they have not been converted to agriculture, timber plantations, or residential developments, Virginia pine is the dominant forest cover, with oaks, hickories, and some loblolly present and scattered with sweet gum, beech, and tulip popular. The understory is usually quite open, and highbush blueberry, low blueberry, huckleberry, and bayberry are present. The herbaceous layer is typically sparse, with green moss, reindeer moss, spotted wintergreen, and panic grasses. Rare species include the Pinkland tick-trefoil, Torrey beakrush, low frostweed, box huckleberry, pine barren gerardia, and Common's panicgrass.

Rich Woods Community.—The rich woods community is a subgroup of the ancient dune community, and is unusual because soil pH is circumneutral. This anomaly with the combination of well drained sandy soil and high pH has resulted in a mixed deciduous community with Piedmont affinities found along the east side of the Nanticoke River. Two state-listed species, the endangered cream-flowered tick-trefoil and the threatened wild lupine are associated with these habitats. Fire is an important disturbance factor that promoted the suitability of these habitats for the dune-adapted species.

Upland Forestlands.—The study area stands apart from other portions of the Delmarva Peninsula because of the extensive unbroken upland and palustrine forests. Thirty-eight percent of the study area is forested, including the largest continuous pine forest left on the Delmarva Peninsula. Pine (mainly loblolly), hardwood, and mixed pine and hardwood are the main forest types. Loblolly pine is the principle timber tree. The continued presence and expansion of the forest land base in the watershed can be attributed largely to the existence of an economic incentive for private landowners to retain forests.

The Valiant and Linthicum or Buttons Neck Tracts contain the only upland forests on Blackwater NWR. Plantation loblolly pines are the dominant tree species on these upland sites.

Agricultural Lands.—About 43 percent of the land in the study area is used for agriculture. The study area supports about 1,300 animal production farms with poultry being the most common. In fact, the Nanticoke has more animal production units than any other river basin in Maryland. One result of this high level of livestock density is huge quantities of manure, a potential source of nutrients. Major crops include corn, soybeans, sorghum, wheat, and barley. Vegetable crops, including sweet corn, green beans, peas, tomatoes, and potatoes, also are commonly grown. Irrigation is common, and often a necessity for consistent production and high yields. Conservation tillage and no-till farming are widely practiced.

Agricultural lands on the Refuge Complex are limited to Blackwater NWR. Refuge staff currently plant approximately 567 acres in croplands (principally sorghum and corn) with funds received from grants, private donations, and force account monies directly from the refuge's budget. Annual Service funding to support this critically important management program has been reduced from $43,000 in 1989 to $0 in 2000. Unlike cooperative farming where the refuge would only receive a 20- to 25-percent share of the crops produced, this management option allows the refuge to leave all crops unharvested and thereby make 100 percent of all crops grown available to wildlife.

Since the objectives are more directed towards wildlife and their needs, rather than the economics of a private farmer, no insecticides and very limited herbicides are used. The program also allows for more creative and innovative low impact tillage practices, liberal use of filter strips, longer crop rotations utilizing legumes to reduce nitrogen applications, and most importantly, a diversified cropping program directed at meeting the nutritional needs (seasonal carbohydrate demands) of waterfowl, high energy food sources for endangered species, and food resources for migrating songbirds and resident game.

The refuge also plants approximately 320 acres in high protein cool season grasses and forbs (consisting of rye, ladino clover, and wheat, the later acreage often double-seeded with high protein buckwheat), which are browsed heavily by migrating and wintering waterfowl. The refuge's best management practices continue to earn praise and

support from local government officials, the general public, hunters, and adjacent landowners, and are often used to demonstrate to local farmers and students how best to "farm for wildlife."

Bay Island Uplands.—The uplands of the Bay Islands within the study area vary from island to island. Battery Island on Susquehanna NWR is 80 percent lawn surrounded by a few pines and hardwood trees. The uplands of Barren Island are predominantly loblolly pines with a few mixed hardwoods, surrounded by marsh. Watt Island is forested with loblolly pines and mixed hardwoods, surrounded by a fringe of marshland.

The upland hammocks of Smith Island are important nesting sites for wading birds. Twelve hammocks on the Smith Island complex currently contain wading bird rookeries. Generally these hammocks constitute isolated ridges surrounded by marsh or open waters, or are former dredged spoil disposal sites which are also adjacent to marsh or open water. Hammock vegetation is characterized by shrub and tree species such as wax myrtle (*Myrica cerifera*), groundsel bush, 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* spp.).

Inland Island Uplands.— Inland island uplands within the study area are found only on Blackwater NWR, and represent most of the refuge uplands, except for approximately 90 acres of loblolly pine uplands on the Linthicum Tract, and 200 acres of loblolly pines on the Valiant Tract. These islands are dominated principally by a mixture of loblolly pine and hardwood with an open understory, and support most of the refuge's American bald eagle nest sites.

Fauna

The Refuge Complex provides habitat for a rich diversity of wildlife. More than 282 species of birds, 38 species of mammals, and 45 species of reptiles and amphibians occur on the Refuge Complex for at least part of the year. The shallow bays, creeks, and marshes are also famous for their fishery resources. The study area supports significant populations of threatened American bald eagles and endangered Delmarva fox squirrels, and has been specifically recognized in recovery plans for these species. The Nanticoke portion of the watershed has been designated as a TNC Bioreserve, based on the area's rare, threatened and endangered plant and animal species and ecologically significant communities. The refuges within the Refuge Complex were designated as "Important Bird Areas" (IBA) by The American Bird Conservancy in 1996 as part of an international effort to recognize and protect such areas on a global, national, and state basis.

Migratory Birds

Waterfowl

The Refuge Complex is recognized as one of the most significant areas for migratory waterfowl in Maryland. As one of five NAWMP focus areas in Maryland, the Refuge Complex provides habitat for 26 species of ducks, 5 species of geese, and 3 species of swans (including the reintroduced trumpeter swam). Of the duck species, the redhead, canvasback, and wood duck are identified by the NAWMP as high priority species; and the black duck, mallard, northern pintail, and blue-winged teal as priority species. Of these priority species, wood duck, mallard, black duck, gadwall, and blue-winged teal nest on the Refuge Complex, along with the northern shoveler, Canada goose, and mute swan. In addition to providing protection and habitat to the seven high priority and priority species identified in the NAWMP, the Refuge Complex is also noted for supporting the Southern James Bay Canada goose, Atlantic brant, greater and lesser scaup, ring-necked duck, American wigeon, and common eider, which, together with the NAWMP species, are species of Special Management Concern in Region 5.

Approximately 35 percent of the Atlantic Flyway's waterfowl population uses the Chesapeake Bay, and the Refuge Complex is among the most important areas to waterfowl on the Bay. For example, according to the 1993 Midwinter Survey, the study area accounted for almost 40 percent of all puddle ducks and more than 5 percent of all diving ducks observed statewide. The table below shows the average number of waterfowl counted during the Midwinter Waterfowl Inventory of the Blackwater NWR, Chesapeake Island Refuges, and Nanticoke protection area survey

units. The study area supports 10 percent of the Chesapeake Bay canvasback population, and 22 percent of Maryland's wintering black duck population. Our Chesapeake Bay Field Office provided the data shown below.

Table 3.7. Waterfowl counts on the Refuge Complex (45-year means) and their percentage of Maryland's total[ab]

Species	***Blackwater NWR***		***Chesapeake Island Refuges***		***Nanticoke Protection Area***	
	Count	*Percent*	*Count*	*Percent*	*Count*	*Percent*
Canada goose	16,648 ± 520	5.6 ± 0.8	4,318 ± 634	1.6 ± 0.3	6,230 ± 800	2.0 ± 0.2
Snow goose	958 ± 1,840	31.1 ± 6.0	†		1,164 ± 579	4.0 ± 1.9
Tundra swan	356 ± 72	1.6 ± 0.3	1,469 ± 138	5.8 ± 0.5	1,055 ± 209	5.0 ± 1.0
American black duck	2,673 ± 481	7.5 ± 0.7	2,042 ± 307	5.7 ± 0.5	1,944 ± 204	7.0 ± 0.8
∑ dabblers	7,496 ± 1,304	8.8 ± 1.1	4,207 ± 943	4.5 ± 0.5	4,276 ± 478	6.0 ± 0.7
∑ divers	281 ± 105	0.2 ± 0.1	2,525 ± 372	2.6 ± 0.4	4,919 ± 965	4.0 ± 0.6
∑ sea ducks	55 ± 12	0.6 ± 0.1	547 ± 172	6.0 ± 1.8	148 ± 41	2.0 ± 0.4

[a]Forty-five-year means (±1 SE) of Midwinter Waterfowl Inventories on the Refuge Complex and their percentage of Maryland State totals.

[b]Blackwater NWR is Zone 7, Segment 19; Nanticoke protection area is Zone 7, Segment 26; Chesapeake Island Refuges include Zone7, Segments 20, 27, 29.

[c]Counts at Blackwater NWR are of lesser snow geese; counts elsewhere in Maryland primarily are of greater snow geese.

†Data missing

The Atlantic Midwinter waterfowl survey is flown along standardized flight paths along the major rivers and water bodies in the Atlantic flyway, including the Chesapeake Bay. The survey is conducted during the first 2 weeks of January, and provides a comparative index of midwinter waterfowl populations along the flyway. Numbers of species of waterfowl counted on Blackwater, the Chesapeake Island Refuges, and the Nanticoke protection area are tabulated below. The average count for each species for the intervals 1956–1965, 1966–1975, 1976–1985, and 1986–1996 is shown as a percentage of average Chesapeake Bay counts for those time intervals.

The Refuge Complex contains extensive shallow-water habitats, SAV beds, tidal mudflats, miles of fringing low marsh, freshwater moist soil management units, croplands, and cool season grasses and forbs. Each of those provides important wintering forage for a variety of waterfowl. The large eelgrass and wigeon grass beds in the Big Thoroughfare, Terrapin Sand Cove, Shanks Creek, and Back Cove on Smith Island (Martin NWR) are important to migrating and wintering waterfowl as feeding and resting areas. Because of their importance to wintering waterfowl, these areas were closed to the taking of waterfowl by a 1960 Presidential Proclamation Order. Eelgrass is an important food source for American black duck, wigeon, Canada goose, redhead, and brant.

Ducks

Blackwater NWR.—Twenty-four species of ducks use Blackwater NWR annually, and six species reside year-round. Large numbers of migrating ducks use the wetlands of the area during the spring and fall, particularly black duck, blue-winged teal, wood duck, green-winged teal, pintail, wigeon, gadwall, ring-necked duck, and common merganser. In recent years, peak populations of 20,000 to 25,000 have occurred on the refuge from mid-November to late December.

One species of particular interest is the Atlantic blue-winged teal. In an article appearing in the Auk (1932), journal of the American Ornithologists' Union, Oliver Austin of the U.S. Biological Survey reported the first evidence of the Atlantic blue-winged teal in Maryland. Austin's report was based on information obtained in the Blackwater marshes during the period 1929–31. This proved an interesting discovery, as this small species of waterfowl was thought to be only a spring and fall migrant and occasional winter visitor in the Chesapeake Bay, with breeding populations mainly in the pothole region of the Prairie States and the Prairie Provinces of Canada. Austin recorded the events leading to the discovery of the young and nests of the blue-winged teal at Blackwater: On July 13, 1929,

W.G. Tregoe of Cambridge, a warden with the Maryland Game and Inland Fish Commission, found several young that he believed were teal, whose identification was later confirmed by Talbot Denamead, an ornithologist with the U.S. Biological Survey. Additional nests were located and broods were observed during the summers of 1930 and 1931.

In the early 1950's, Robert E. Stewart and John W. Aldrich, Service ornithologists, suspecting that the Chesapeake Bay birds might be morphologically different enough from western or interior breeding populations of blue-winged teal to be a distinct subspecies, collected specimens from Dorchester marshes in May, June, and July. Upon comparing them with museum specimens of breeding birds from the interior, it became apparent that Dorchester County specimens were much darker than those from the Midwest and Prairie Provinces of Canada. In the course of their examinations, they found that all breeding blue-winged teal in the Atlantic Coastal region extending from North Carolina to the Maritime Provinces of Canada were much darker than birds from the interior. Therefore, the men described and named a new geographic race or sub-race of the species, *Anas discors orphna*, the Atlantic blue-winged teal. The center of abundance of the Atlantic blue-winged teal breeding population is in the brackish tidal marshes of New Jersey, Delaware and Maryland, particularly in Dorchester County, and the Delaware Bay marshes of Delaware and New Jersey. (Stewart and Aldrich, 1956).

Duck roost counts on Blackwater NWR usually are conducted from mid-August to early October, mainly as an index to numbers of roosting wood ducks. Counts have been conducted in the late evening at two locations on the upper Blackwater River and one location on the Little Blackwater River. Roost counts were not conducted in 1999, due to insufficient staffing and adjustments in workloads and priorities. Blackwater NWR historically has maintained approximately 200 wood duck boxes, and an average of approximately 600 wood ducks has been fledged annually.

Martin NWR.—On Martin NWR (Smith Island), wigeon, pintail, black duck, and mallard are the principal species that peak from 10,000 to 15,000 in early December. Black ducks and mallards frequently nest on Martin. A breeding pair count, completed in April 1988, yielded a breeding population index of 734 black ducks and 57 mallards. Smith Island harbors an important proportion of the midwinter population of dabbling ducks on the Chesapeake Bay: 2.27 percent of the counts for the entire Chesapeake Bay from 1956 – 1996. Over this time period, the islands contained more than 1 percent of the Chesapeake Bay midwinter counts for the following species: black duck, gadwall, widgeon, and pintail. Also, Smith Island contained more than 1 percent of the Chesapeake Bay midwinter counts for five other species of waterfowl: redhead, bufflehead, scoter, old squaw, brant, and tundra swan. It concentrates a major portion of the midwinter waterfowl population on about 0.0001 percent of the shoreline of the entire Chesapeake Bay.

Atlantic Population (AP) Canada Geese

Prior to 1940, it was considered rare for Canada geese to winter on Blackwater NWR or other units of the Refuge Complex. However, with the introduction of the mechanical corn picker and a shift in agriculture from truck farming to row crops (corn and soybeans), AP Canada geese began wintering on the Eastern Shore of Maryland in numbers greater than any other locality in North America. According to Bellrose, the mid-Atlantic population of wintering Canada geese during the period 1970–1975 was as follows: central and western New York, 8,000; western Pennsylvania, 26,000; Delaware and Maryland (Delmarva Peninsula), 537,000; coastal Virginia, 60,000; North Carolina, 58,000; and South Carolina, 10,500.

A large segment of the goose population wintering in the Chesapeake Bay formerly wintered farther south, particularly along the Outer Coastal Plain of North Carolina. The so-called “short-stopping” of many geese somewhat farther north of the former range occurred as the more inefficient mechanical corn picker began leaving as much as 10 percent of the crop in the field for the birds to forage on. Farmers began planting more corn and soybeans as truck farming was being discontinued. More food equated to more geese, and for the next 30 years the trend continued to increase. An example of the increase in Canada geese is seen in population figures at Blackwater NWR. In the 1940's, approximately 5,000 geese visited the refuge in the winter, but by the mid-1970's the annual population increased to about 100,000 at the peak of migration.

In an attempt to make geese move to their historical wintering areas, wildlife management agencies extended seasons and bag limits. It was thought that if enough “gunning” pressure could be applied, then the geese would simply fly south. But the geese did not fly south, and in the following decade, when production was at record lows,

over-harvest occurred and the population plummeted. For example, in 1983 hunters harvested more than 280,000 Canada geese in Maryland, more than occurred in the entire state by the mid 1990's. Winter counts of AP Canada geese in Maryland declined from about 608,000 in 1980 to a low of 217,700 in 1997 before they started to rebound slightly. Alarmed by these declines in wintering populations and the lack of production on the breeding grounds, it became necessary in 1995 to close the hunting season on Canada geese.

Geese that winter at Blackwater NWR and other areas of the Refuge Complex nest along the eastern margin of James Bay and Hudson Bay as well as the interior of Ungava. Following the breeding season and summer molt, geese begin to stage in areas near the coast of James and Hudson Bays preparatory to migration southward. The main migration corridor south is through southern Quebec, across Lake Ontario, into central New York, and down through eastern Pennsylvania to Chesapeake Bay. The first birds arrive at Blackwater in late September, historically with numbers increasing through October, until a peak population is reached in November.

Following the season closure in 1995, the number of AP geese breeding in northern Quebec increased from 29,000 pairs in 1995 to 77,500 pairs in 1999. This increase in breeding population is largely the result of a shift in age structure (i.e. young geese reaching breeding age). The annual breeding pair survey of AP geese on the Ungava Peninsula provides the most reliable measurement of this population, an estimate free from contamination by other populations of Canada geese. In 1996, the Atlantic Flyway Council approved an Action Plan to address the immediate survey and research needs to rebuild the AP flock to its former level of abundance. The goal of this Plan is to reestablish 150,000 breeding pairs in the Ungava Region. It explains that no additional harvest of AP geese will be considered until the population index reaches 60,000 pairs with evidence of a sustained recovery. In 1999, managers agreed that sufficient recovery of AP geese had occurred to warrant a limited harvest of about 35,000 birds or a harvest rate of 5 percent. Maryland was offered 12,000 of the 35,000 flyway harvest, but Maryland hunters requested that the season remain closed until a more liberal season could be implemented.

During the past 10 years, the Refuge Complex has played an important role in assisting the State to recover AP geese. Unquestionably, one of the most important contributions has been Blackwater NWR's cropland management program, and the 1989 decision to eliminate cooperative farming in lieu of force account farming, thereby leaving 100 percent of the crops available for the wintering waterfowl.

Lesser Snow Geese

Although both greater and lesser snow geese (*Anser caerulescens c.*) winter on Blackwater NWR, the lesser snow goose is found in greater abundance. It is rather rare for lesser snow geese to winter in the Atlantic Flyway, since the traditional winter grounds are in the Lower Mississippi Valley, along the Texas coast, and in the Central Valley of California. The lesser snow goose flock at Blackwater is also unique in that almost 50 percent of the flock is of the blue phase.

Swans

Tundra swans, destined for Chesapeake Bay wintering grounds, migrate south from the northwest arctic and subarctic tundra breeding areas, by way of northern Alberta and Saskatchewan, the Devils Lake area of North Dakota, across the Great Lakes to the Middle Atlantic area. Some come from as far as the Alaskan Northern Slope near the Prudhoe Bay oil fields. During fall migrations, swans make tremendous long-distance flights. Tundra swans can be found on all the units of the Refuge Complex except Susquehanna NWR. The species is particularly attracted to the Chesapeake Island Refuges because of the abundance of SAV and several species of mollusks (the Baltic macoma clam and the long clam). Mute swans, an exotic species, are discussed in "Exotic and Invasive Species," below.

Forest Interior Dwelling Species

Forest interior dwelling species (FIDS) of birds require large forest areas to breed successfully and maintain viable populations. This diverse group includes colorful Neotropical migrant songbirds, such as tanagers, warblers, and vireos that breed in North America and winter in the Caribbean and Central and South America, as well as residents and short-distance migrants, such as woodpeckers, hawks, and owls. FIDS are an integral part of

Maryland's landscape and natural heritage. They have depended on large forested tracts, including streamside and Bayside forests, for thousands of years (A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area, June 2000).

FIDS act as "umbrella species" for a wide range of forest benefits, and are an important component of a natural forest system. They spread seeds through their droppings, help control insect numbers, and provide food to those higher on the food chain. The habitat needs of FIDS overlap those of many other plant and animal species including large mammals, many wildflower species, wood frogs, and wild turkey. When sufficient habitat is protected to sustain a diversity of forest birds, other important components and microhabitats of the forest will be encompassed and be protected. These may include the small, forested streams and headwaters critical for fish populations and the vernal pools necessary for the survival of amphibians. Forest birds are also an important link in a complex food web. Warblers and other insectivores eat untold numbers of insects such as spruce budworms and caterpillars, helping to keep these defoliators in check (Yahner 1995).

Although most of these birds are still fairly common, populations of some forest bird species have been declining during the last 30 – 40 years. According to the Breeding Bird Survey (BBS), there was a 63-percent decline in occurrence of individual birds of Neotropical migrant species (many of which are FIDS) in Maryland from 1980 – 1989. While many factors have contributed to the decline of FIDS populations, including the loss of habitat on wintering grounds and loss of migratory stopover areas for Neotropical migrants, the loss and fragmentation of forests on the breeding grounds here in North America appear to play a critical role. FIDS generally are more successful at survival and reproduction in large, older, hardwood-dominated forests. However, there has been a loss of quality habitat through the conversion of hardwood and mixed-hardwood forests to pine and the reduction of "old growth" forest to small isolated patches. Prior to European settlement it is estimated that old-growth forest covered approximately 95 percent of the Chesapeake watershed (Kraft and Brush, 1981). Forest coverage in Maryland today is about 44 percent (USDA Forest Service 1996) and about 40 percent of the remaining deciduous forest in the East today consists of small, isolated woodlots of relatively immature trees in agricultural and suburban landscapes. When European settlers arrived in eastern North America in the 1600's, the average height of a hardwood tree was 100 feet or more. The average height of trees in the Chesapeake Bay region today is only 60-80 feet (USDA Forest Service 1996).

The fragmented, younger forest found in the Chesapeake Bay region has several negative effects on FIDS. The direct loss of forest habitat results in smaller forest tracts that may no longer be adequate to accommodate a bird's territory, to provide an ample supply of food, or to provide the necessary forest structure for breeding. Many forest tracts are too small to support species with large breeding territories such as the red-shouldered hawk, barred owl, and pileated woodpecker. For example, a breeding pair of red-shouldered hawks requires from 250-625 acres to sustain them. Most FIDS, even those species that have small breeding territories, will only select larger forest tracts for breeding: They are area-sensitive. In addition to area requirements, many FIDS have additional habitat requirements for nesting. Reduction of forest size often results in the loss of specialized habitats/microhabitats.

Forest fragmentation also leads to indirect effects on FIDS that are associated with an increase in edge. Edges are commonly associated with higher rates of nest predation, increased brood parasitism by brown-headed cowbirds, increased rates of human disturbance (including noise), and invasion by exotic flora. Edge is most detrimental when a forest adjoins a lawn, agricultural field, pasture, or wide road. We have defined "edge" as forest within 100 m of the forest edge, which is consistent with the definition used by the Chesapeake Bay Critical Area Commission (A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area, June 2000), recommended widths of riparian forests (Keller et al. 1993), and the criteria used by Robbins et al. (1989) to distinguish forest patches. The area within this 100-m edge is defined as "interior" habitat and is measured by changes in "effective area"; i.e., total forested area minus the area within the forest edge. Interior habitat functions as the highest quality breeding habitat for FIDS.

Blackwater NWR currently contains much of the remaining large, contiguous tracts of forested lands on the Delmarva Peninsula. Twenty-five species of forest interior dwelling (FID) birds potentially breed in the Mid-Atlantic Coastal Plain (A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area, June 2000). Twenty of the 25 species are Neotropical migrants, species which nest in temperate North America and winter in Central and South America. The cerulean warbler, veery, and black-throated green warbler were eliminated from this list because they are unlikely species to be breeding on Blackwater NWR (H. Armistead,

D. Dawson, J. McCann, pers. comm). Consequently, twenty-two of these FIDS are potential breeders on Blackwater NWR and 20 species have been documented during the breeding forestbird survey in the past 5 years (table 3.8).

Forestry practices need not be detrimental to FIDs. Forests can be thinned and harvested in ways that FID habitats are not harmed, and in many cases are actually improved. Conservation of FID habitat is required by law within the Chesapeake Bay Critical Area and recommended in all other parts of the state. To minimize the impact of forestry practices on FIDs, silvicultural prescriptions for different forest types will generally follow those outlined by the FIDS/Forestry Task Force (June 1999) unless it specifically conflicts with critical habitat requirements of the Delmarva fox squirrel.

Table 3.8. Twenty-two FID's potentially breeding on Blackwater NWR[1]

Species[a]	***Status in mid-Atlantic Coastal Plain***[b]	***PIF rank***[c]	***% occurrence at BNWR***[d]	***Minimum area (ha) for breeding***[e]
Swainson's warbler (*Limnothlypis swainsonii*)	B	26	nd	*350
Wood thrush (*Hylocichla mustelina*)	B	24	27.9	1
Kentucky warbler (*Oporornis formosus*)	B	23	8.2	17
Worm-eating warbler (*Helmitheros vermivorus*)B	23	50.8	150	
Acadian flycatcher (*Empidonax virescens*)	B	22	47.5	15
Louisiana waterthrush (*Seiurus motacilla*)	B	22	3.3	350
Prothonotary warbler (*Protonotaria citrea*)	B	22	13.1	*100
Yellow-throated vireo (*Vireo flavifrons*)	B	22	6.6	*100
Hooded warbler (*Wilsonia citrina*)	B	21	†	*35
Scarlet tanager (*Piranga olivacea*)	B	21	13.1	12
Whip-poor-will (*Caprimulgus vociferus*)	B	21	1.6	*125
Northern parula (*Parula americana*)	B	19	1.6	520
Black-and-white warbler (*Mniotilta varia*)	B	18	1.6	220
Ovenbird (*Seiurus aurocapillus*)	B	18	65.6	6
Brown creeper (*Certhia americana*)	D	15	†	na
Red-shouldered hawk (*Buteo lineatus*)	R	15	8.2	225
Red-eyed vireo (*Vireo olivaceus*)	B	15	62.3	3
American redstart (*Setophaga ruticilla*)	B	14	†	*35
Broad-winged hawk (*Buteo platypterus*)	B	14	nd	na
Hairy woodpecker (*Picoides villosus*)	R	14	26.2	7
Pileated woodpecker (*Dryocopus pileatus*)	R	14	54.1	165
Barred owl (*Strix varia*)	R	13	3.3	*100

[1] "The status of 22 forest interior dwelling bird species potentially breeding on Blackwater NWR and their rankings as species of concern in the draft Mid-Atlantic Coastal Plain Bird Conservation Plan by Partners In Flight (PIF)."

[a] Species list from A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area (draft 6 Oct 1999). Species in **boldface** are considered highly area-sensitive.

[b] Local status refers to migratory status in the mid-Atlantic Coastal Plain. Codes are: B=species that breed in the region but do not winter (these species primarily are Neotropical migrants, but may also include some temperate-zone migrants), D=species that breed and winter in the region, and R=resident or nonmigratory species (Watts 1999). Supplemental data from Robbins and Blom (1996).

[c] Total concern scores for species breeding within the mid-Atlantic Coastal Plain (appendix V *in* Watts 1999); presented in decreasing order of concern (maximum value=30).

[d] Species detected during 5-min counts (variable distance) on 61 points distributed at 500-m intervals in estuarine and palustrine forest (NWI data from Delaware Bay Estuary Program); sampled during 23 May–18 July in 1996–2000; †=known to occur on the refuge (H. Armistead, pers. comm.) but not detected during surveys; nd=not known to occur on the refuge.

[e] Values without asterisks are from Robbins, et al. (1989); values with asterisks are from Bushman and Therres (1988); na=data not available.

Migratory Nongame Species of Management Concern

The Refuge Complex hosts 68 of the 70 migratory nongame birds of management concern in Region 5.

Raptors

The Refuge Complex provides habitat for 24 raptor species. Direct management now focuses on peregrine falcons, osprey, and barn owls.

Arctic Peregrine Falcon.—Peregrine falcons (*Falco peregrinus tundrius*) regularly use the Refuge Complex, particularly the Chesapeake Island Refuges. Martin NWR historically has been noted for its concentration of peregrine falcons during the migration period, when six or more regularly can be observed. Peregrine falcons nest on two artificial towers on Martin NWR, a tower on Watts Island, and a tower placed on Spring Island in 1998 by Navy personnel and our Chesapeake Bay Field Office to replace the nest on Adams Island (see table 3.9).

Table 3. 9. Peregrine falcon production on Martin NWR

Year	Siners Tower		Anderson Tower		Watts Island
	Eggs	Fledged	Eggs	Fledged	Fledged
1986	4	3			
1987	4	4			
1988	4	4			
1989	4	2	Structure built		
1990	4	3	No nest		
1991	4	3	No nest		
1992	2	2	2	1	
1993	4	4	4	3	
1994	5	3	3	2	
1995	5	2	5	5	
1996	3	1	4	4	
1997	3	1	5	5	
1998	2	1	4	3	
1999	2	0	4	0	
2000		0		3	3
Total	50	33	31	26	3

Source: Martin NWR annual narrative reports, except 1999 and 2000, Mike Harrison pers.comm.

Osprey.—Both Blackwater and Martin NWRs maintain artificial osprey nesting platforms: 70 on Martin NWR and 30 on Blackwater NWR (see tables 3.10 and 3.11 below).

Barn Owl.—See table 3.12, below.

Shorebirds, Gulls, Terns, and Allied Species

The Refuge Complex provides diverse shallow water habitats that support 52 species of shorebirds, gull, terns, and allied species. Rare and State-listed threatened species include the black-necked stilt and least tern. The following species nest on the Refuge Complex: laughing gull, herring gull, great black-backed gull, royal tern, common tern, Forster's tern, least tern, black skimmer, killdeer, American oystercatcher, willet, and woodcock. Shorebird surveys of the moist soil management units on Blackwater NWR have been conducted weekly since May 31, 1996.

Marsh and Water Birds

The shallow waters and marshes of the Refuge Complex provide excellent feeding areas for 30 species of marsh and water birds. The Chesapeake Bay's most important heron and egret rookeries are located on Martin NWR, Watts Island, Bishops Head, Barren Island, and within the Nanticoke protection area. Little blue, tricolored, and green-backed herons; black-crowned and yellow-crowned night-herons; great, snowy, and cattle egrets; glossy ibis; clapper, king, Virginia, and black rails; common moorhen; least and American bitterns; and double-crested cormorants all nest on the Refuge Complex. Spring Island contains the northernmost brown pelican colony in the United States; it produced more than 1,200 young in 2000.

The Chesapeake Island Refuges

The Coastal Plain is the most important physiographic region in Maryland for breeding colonial water birds. Chesapeake Bay islands within this region provide particularly important habitats for bird colonies. According to Maryland surveys, in 1995, Somerset County contained 20 percent of the state's total colonial water bird colonies, and 23 percent of the total breeding pairs (Brinker, et al. 1996).

Table 3. 10. Osprey production at Blackwater NWR (1978-2001)

Year	*Occupied Nest*[1]	*Active Nest*[2]	*Successful Nest*[3]	*Eggs*	*Fledglings*	*Ratio*[4]
2001	25	25	25	60	54	.90
2000	28	28	28	75	65	.87
1999		28			57	
1998	32	32	29	72	68	.94
1997	34	34	34	77	71	.92
1996	36	36	30	90	71	.79
1995	28	28	25	68	61	.90
1994	36	36	31	81	65	.80
1993	30	29	26	69	58	.84
1992	29	28	19	69	40	.58
1991	24	24	22	60	47	.78
1990	28	25	20	51	43	.84
1989	23	23	16	51	37	.73
1988	30	28	22	60	45	.75
1987	22	22	19	49	37	.75
1986	25	21	12	48	26	.54
1985	20	19	14	37	29	.78
1984	18	18	11	21	28	1.33
1983	17	17	10	20	21	1.05
1982	13	13				
1981	15	15	6	16	15	.94
1980	9	9	4	15	8	.53
1979	8	8				
1978	6	6	3	6	5	

Source: Blackwater NWR data and narrative reports
Blanks indicate missing data
[1]Nests with adults present
[2]Nests containing eggs
[3]Nests with fledglings
[4] Ratio of fledglings to eggs; due to incomplete egg counts fledglings may exceed eggs

Smith Island has one of the highest numbers of colonial water bird colonies per area in the State: 12 active breeding colonies for wading birds were recorded there in 1995. Five species of heron, three species of egret, and glossy ibis breed at Smith Island, according to State surveys. This census does not include green herons, which have also been recorded breeding on Smith Island (Amistead 1974).

Brinker, et al. (1996) reported that four of the nine species of wading birds that breed at Smith Island have shown significant declines in Maryland between 1985 and 1995 (snowy egret, tricolored heron, black-crowned night-heron, and glossy ibis). Declines for these species may be the result of a variety of factors, including habitat disturbance or loss, altered prey bases, increases in competing species, increases in predators, or exposure to contaminants. Because colonial water birds concentrate reproductive efforts at a few, discrete locations, these populations are particularly sensitive to habitat disturbance or loss. The Maryland population of glossy ibis has declined by approximately 50 percent since 1985, primarily attributable to a major disturbance at the Point Comfort colony on Smith Island. The Maryland Department of Natural Resources, Wildlife and Heritage Division has placed a high priority upon protection from human disturbance and erosion for colonial water bird rookeries (Brinker et al. 1996).

Rookeries at Smith Island are located on isolated ridges surrounded by marsh (hammocks), vegetated primarily with woody shrubs, i.e. wax myrtle (*Myrica cerifera*), groundsel tree (*Baccharis halimifolia*), and marsh elder (*Ivafrutescens*); trees, e.g., black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), and hackberry (*Celtis occidentalis*); and vines, e.g., japanese honeysuckle (*Lonicera japonica*), poison ivy (*Toxicodendron radicans*), and blackberry (*Ribes spp.*). Hammocks are generally small sites (1–20 acres), isolated from larger land masses by extensive tracts of black needlerush (*Juncus roemerianus*) marsh and tidal creeks. Some hammocks are topographic high points in the landscape that have become isolated due to land subsidence and sea level rise; others are dredged material disposal areas that were originally, in part, tidal marsh.

Table 3. 11. Osprey production at Martin NWR (1978-2001)

Year	*Occupied Nest*[1]	*Active Nest*[2]	*Successful Nest*[3]	*Eggs*	*Fledglings*	*Ratio*[4]
2001	30	29		78	67	.86
2000	28	28	58	69	65	.87
1999	57	31	30		49	
1998	53	45	36	130	58	.45
1997	51	39	29	101	44	.44
1996					67	
1995	55			117	.38	.32
1994	56	41	33	114	60	.53
1993	54	28	17	71	21	.30
1992	49	8	7	14	9	.64
1991	58	21	15	53	30	.57
1990	55	36	15	98	28	.29
1989	53		4		6	
1988	55	48	30	134	50	.37
1987	53	45	32	123	70	.57
1986	56	34	18	90	36	.40
1985	55	31	25	86	44	.51
1984	49	30	16	77	31	.40
1983	44	34	21	81	37	.46
1982	44	32	26	87	45	.52
1981	37	29	18	69	31	.45
1980	44	35	26	86	50	.58
1979		42	39	40	36	.90
1978		26	18	46	36	.78

Source: Martin NWR data and narrative reports
Blanks indicate missing data
[1]Nests with adults present
[2]Nests containing eggs
[3]Nests with fledglings
[4] Ratio of fledglings to eggs; due to incomplete egg counts fledglings may exceed eggs

About 12 hammocks on Smith Island now contain important wading bird rookeries. Three of these, Cherry Island, Wellridge Creek, and Lookout Tower, are part of Martin NWR. The other areas are privately owned wooded islands scattered across the southern half of Smith Island, south of the Big Thoroughfare navigation channel.

Wooded island habitats in the Chesapeake Bay, exposed to little disturbance by humans or mammalian predators, provide important breeding sites for migratory birds such as colonial water birds (Erwin and Spendelow 1991), waterfowl, and certain raptors. These sites also provide important resting and staging areas for migratory songbirds. Habitats for many of these species have been severely limited on the mainland surrounding the Bay because of development, human disturbance, cultivation, and exposure to predation by domestic animals.

Recent studies have demonstrated that erosional loss of Chesapeake Bay island habitats has accelerated during the last century, due to sea-level rise and land subsidence (Wray, et al. 1995, Kearney and Stevenson 1991). Recent studies on three wooded islands in the Chesapeake Bay (Barren, James, and Poplar Islands) suggest that these habitats are eroding along western shorelines at an average rate of 4.96 m/yr = *:0.12 (Wray et al. 1995). Erosion on Eastern Shore islands in the middle portion of the Bay (Galenter 1990) has reduced nesting habitats, which has a negative impact on colonial water birds, waterfowl, and migratory songbirds. Habitat loss for wading birds breeding in the Bay region increases risks of predation, disease, and natural disasters (storms, oil spills, etc.) (Erwin and Spendelow 1991). Waterfowl researchers have correlated the loss of isolated islands, along with increased shoreline development, with the decline of black ducks in the Chesapeake Bay (Krementz et al. 1991).

Table 3. 12. Barn owl nest box productivity (Blackwater NWR) 1988-2000

Year	*Nests*	*Young*	*Fledglings*
2000	11	78	73
1999	10	29	29
1998	13	50	50
1997	13	53	44
1996	10	50	50
1995	11	54	54
1994	11	50	49
1993	13	15	15
1992	14	30	30
1991	13	66	66
1990	10	67	70
1989	12	61	59
1988	14	---	46

Erosion poses the greatest threat for water bird colonies on Smith Island. For example, one hammock now used by black-crowned and yellow-crowned night-herons is threatened by erosion near Rhodes Point. Erosion has been slowed by placing dredged material and geotextile tubes along the shoreline adjacent to this shrub community. However, the shoreline is still eroding, especially at the north end of the geotextile tubes.

Some of the rookery sites are associated with dredged material disposal sites. Also, red foxes (*Vulpes vulpes*) populate the island. While they generally do not pose a threat to wading birds nesting high in trees, they may now limit the ability of those birds to breed in shrub communities on the hammocks.

Table 3.13. Breeding pairs of colonial nesting waterbird species for eight years

Species	*Alpha*	*Colony*	*ID*	*Location*	*1975*	*1976*	*1977*	*1985*	*1986*	*1987*	*1988*	*1995*
Cattle Egret	CAEG	Barren Is	DOR002	Barren Is	0	0	51	0	0	0	0	
Glossy Ibis	GLIB	Barren Is	DOR002	Barren Is	0	0	6	0	0	0	0	
Great Blue Heron	GBHE	Barren Is	DOR002	Barren Is	160	340	390	161	465	368	360	400
Great Egret	GREG	Barren Is	DOR002	Barren Is	140	125	180	60	35	60	162	175
Snowy Egret	SNEG	Barren Is	DOR002	Barren Is	0	0	90	0	0	0	0	
Black-crowned Night-Heron	BCNH	Fin Creek	DOR004	Bloodsworth Is	0	0	5	0	2	0	0	
Great Blue Heron	GBHE	Fin Creek	DOR004	Bloodsworth Is	209	263	101	128	124	130	121	90
Great Egret	GREG	Fin Creek	DOR004	Bloodsworth Is	8	0	0	0	1	0	0	
Green-backed Heron	GRHE	Fin Creek	DOR004	Bloodsworth Is	0	0	15	2	0	0	0	
Yellow-crowned Night-Heron	YCNH	Fin Creek	DOR004	Bloodsworth Is	0	0	1	0	0	0	0	
Black-crowned Night-Heron	BCNH	Adam Is	DOR005	Adam Is	8	0	7	0	0	0	0	
Great Blue Heron	GBHE	Adam Is	DOR005	Adam Is	20	15	10	15	1	6	14	8
Great Egret	GREG	Adam Is	DOR005	Adam Is	4	6	1	0	0	0	0	2
Green-backed Heron	GRHE	Adam Is	DOR005	Adam Is	2	0	3	0	1	0	0	
Little Blue Heron	LBHE	Adam Is	DOR005	Adam Is	6	0	0	0	0	0	0	
Snowy Egret	SNEG	Adam Is	DOR005	Adam Is	4	0	0	0	0	0	0	
Tricolored Heron	TRHE	Adam Is	DOR005	Adam Is	3	0	0	0	0	0	0	
Yellow-crowned Night-Heron	YCNH	Adam Is	DOR005	Adam Is	7	0	3	0	0	0	0	2
Black-crowned Night-Heron	BCNH	Holland Is	DOR006	Holland Is	156	39	38d	0	0	2	0	12
Cattle Egret	CAEG	Holland Is	DOR006	Holland Is	36	15	40d	0	0	0	0	35
Common Tern	COTE	Holland Is	DOR006	Holland Is			21	0	0	0	0	
Glossy Ibis	GLIB	Holland Is	DOR006	Holland Is	46	1+	16d	0	0	0	0	16
Great Blue Heron	GBHE	Holland Is	DOR006	Holland Is	48	13	50	3	0	1	4	54
Great Egret	GREG	Holland Is	DOR006	Holland Is	73	22	27c	0	0	6	8	88
Green-backed Heron	GRHE	Holland Is	DOR006	Holland Is	19	AA	5d	1	0	5	0	
Herring Gull	HEGU	Holland Is	DOR006	Holland Is			5	0	0	0	0	
Little Blue Heron	LBHE	Holland Is	DOR006	Holland Is	56	22c	22c	0	0	0	0	90
Snowy Egret	SNEG	Holland Is	DOR006	Holland Is	292	115	100	0	0	0	0	202
Tricolored Heron	TRHE	Holland Is	DOR006	Holland Is	46	13	23d	0	0	0	0	104
Yellow-crowned Night-Heron	YCNH	Holland Is	DOR006	Holland Is	37	8c	8c	10	18	3	18	8
Black-crowned Night-Heron	BCNH	N Holland Is	DOR008	Holland Is	201	32	37d	0	0	0	0	
Cattle Egret	CAEG	N Holland Is	DOR008	Holland Is	14	6	40d	0	0	0	0	
Glossy Ibis	GLIB	N Holland Is	DOR008	Holland Is	14	0	17d	0	0	0	0	
Great Blue Heron	GBHE	N Holland Is	DOR008	Holland Is	43	27	50	0	0	0	0	
Great Egret	GREG	N Holland Is	DOR008	Holland Is	40	35	28c	0	0	0	0	
Green-backed Heron	GRHE	N Holland Is	DOR008	N Holland Is	A	AA	5d	0	0	3	0	
Little Blue Heron	LBHE	N Holland Is	DOR008	Holland Is	17	23c	23c	0	0	0	0	
Snowy Egret	SNEG	N Holland Is	DOR008	Holland Is	85	60	100	0	0	0	0	
Tricolored Heron	TRHE	N Holland Is	DOR008	Holland Is	15	3	22d	0	0	0	0	
Yellow-crowned Night-Heron	YCNH	N Holland Is	DOR008	Holland Is	2	7c	7c	5	0	7	12	20
Black-crowned Night-Heron	BCNH	Piney Is Pt	DOR013	Bloodsworth Is	0	8		0	6	7	0	

Species	*Alpha*	*Colony*	*ID*	*Location*	*1975*	*1976*	*1977*	*1985*	*1986*	*1987*	*1988*	*1995*
Great Blue Heron	GBHE	Piney Is Pt	DOR013	Bloodsworth Is	0	25	A					25
Great Egret	GREG	Piney Is Pt	DOR013	Bloodsworth Is	0	25	A	0	0	4	0	
Green-backed Heron	GRHE	Piney Is Pt	DOR013	Bloodsworth Is				0	5	2	0	
Snowy Egret	SNEG	Piney Is Pt	DOR013	Bloodsworth Is				0	0	3	0	
Tricolored Heron	TRHE	Piney Is Pt	DOR013	Bloodsworth Is				0	0	3	0	
Great Blue Heron	GBHE	Bloodsworth Pt	DOR015	Bloodsworth Is								2
Great Egret	GREG	Bloodsworth Pt	DOR015	Bloodsworth Is				20	14	0	0	
Black-crowned Night-Heron	BCNH	Bishop's Head Pt	DOR028	Bishop's Head								2
Green-backed Heron	GRHE	Bishop's Head Pt	DOR028	Bishop's Head						6	5	
Common Tern	COTE	Whitewood Cove	DOR029	Barren Is				0	0	0	48	234
Forster's Tern	FOTE	Whitewood Cove	DOR029	Barren Is								285
Laughing Gull	LAGU	Whitewood Cove	DOR029	Barren Is								4
Great Black-backed Gull	GBBC	Spring Is	DOR031	Spring Is								20
Herring Gull	HEGU	Spring Is	DOR031	Spring Is								376
Black-crowned Night-Heron	BCNH	Cherry Is	SOM002	Martin NWR	200	AA	110	A	A	10	22	3
Cattle Egret	CAEG	Cherry Is	SOM002	Martin NWR	80	AA	145	0	0	0	0	15
Glossy Ibis	GLIB	Cherry Is	SOM002	Martin NWR	120	AA	A	A	A	9	9	63
Great Blue Heron	GBHE	Cherry Is	SOM002	Martin NWR	60	AA	60	230	185	250	177	54
Great Egret	GREG	Cherry Is	SOM002	Martin NWR	80	AA	25	80	A	43	119	50
Green-backed Heron	GRHE	Cherry Is	SOM002	Martin NWR	14	AA	A	A	A	A	A	
Little Blue Heron	LBHE	Cherry Is	SOM002	Martin NWR	20		0	A	A	1	0	10
Snowy Egret	SNEG	Cherry Is	SOM002	Martin NWR	125	AA	72	A	A	3	4	20
Tricolored Heron	TRHE	Cherry Is	SOM002	Martin NWR	80	AA	0	A	A	5	0	41
Yellow-crowned Night-Heron	YCNH	Cherry Is	SOM002	Martin NWR	25	AA	3	A	A	21	17	41
Great Egret	GREG	Noah Ridge	SOM003	Martin NWR	2			0	0	0	0	
Green-backed Heron	GRHE	Noah Ridge	SOM003	Martin NWR	10							
Tricolored Heron	TRHE	Noah Ridge	SOM003	Martin NWR	2			0	0	0	0	
Yellow-crowned Night-Heron	YCNH	Noah Ridge	SOM003	Martin NWR	18			0	0	0	0	
Yellow-crowned Night-Heron	YCNH	Wop Is	SOM005	Martin NWR				12	9	2	8	
Yellow-crowned Night-Heron	YCNH	Otter Creek	SOM010	Martin NWR				0	0	0	0	
Black-crowned Night-Heron	BCNH	Wellridge Creek	SOM025	Martin NWR								1
Cattle Egret	CAEG	Wellridge Creek	SOM025	Martin NWR								3
Glossy Ibis	GLIB	Wellridge Creek	SOM025	Martin NWR								3
Great Blue Heron	GBHE	Wellridge Creek	SOM025	Martin NWR	27	22	A	0	0	0	0	16
Great Egret	GREG	Wellridge Creek	SOM025	Martin NWR								64
Little Blue Heron	LBHE	Wellridge Creek	SOM025	Martin NWR								2
Snowy Egret	SNEG	Wellridge Creek	SOM025	Martin NWR								5
Tricolored Heron	TRHE	Wellridge Creek	SOM025	Martin NWR								24

Species	*Alpha*	*Colony*	*ID*	*Location*	*1975*	*1976*	*1977*	*1985*	*1986*	*1987*	*1988*	*1995*
Yellow-crowned Night-Heron	YCNH	Wellridge Creek	SOM025	Martin NWR				8	A	2	9	6
Great Black-backed Gull	GBBC	Sawney Cove	SOM030	Martin NWR								12
Herring Gull	HEGU	Swaney Cove	SOM030	Martin NWR				127	111	181	250	176
Cattle Egret	CAEG	Lookout Tower	SOM041	Martin NWR								271
Glossy Ibis	GLIB	Lookout Tower	SOM041	Martin NWR								65
Great Egret	GREG	Lookout Tower	SOM041	Martin NWR								3
Little Blue Heron	LBHE	Lookout Tower	SOM041	Martin NWR								61
Snowy Egret	SNEG	Lookout Tower	SOM041	Martin NWR								61
Tricolored Heron	TRHE	Lookout Tower	SOM041	Martin NWR								169
Yellow-crowned Night-Heron	YCNH	Lookout Tower	SOM041	Martin NWR								58
Great Black-backed Gull	GBBC	Terrapin Sand Pt	SOM044	Martin NWR								9
Herring Gull	HEGU	Terrapin Sand Pt	SOM044	Martin NWR								134
Great Black-backed Gull	GBBC	Drum Pt Is	SOM048	Martin NWR								3
Herring Gull	HEGU	Drum Pt Is	SOM048	Martin NWR								13

*1975–1977, 1985–1988, and 1995
Sources: Maryland Water bird Study Final Report, Project FW-8-P, Univ. MD, Center for Environmental and Estuarine Studies, Appalachian Environmental Laboratory (1975-1977 and 1985-1988 data) and Population Trends of Colonial Nesting Water birds on Maryland's Coastal Plain, Final Report, MD DNR, September 1996 (1995 data)

Legend
Blanks represent data not available or no census on that site that year.
A - Colony site active, but no census
AA - Based upon colony site history, colony site assumed active.
c - Previous investigators combined the two colony sites on Holland Is into one count. Here that count is evenly divided between the two sites.
d - Erwin & Korschgen (1979) combined the two colony sites on Holland Is into one count. Here that count is evenly divided between the two sites.

Breeding Songbirds

Eighty-five different species of songbirds nest in Blackwater NWR's forested wetlands. Five years of breeding bird surveys began in 1996 on the Greenbriar Swamp, Moneystump, and Gum Swamp Tracts. We maintain eastern bluebird boxes on the refuge; recently, the box program has fledged as many as 147 young annually. Information is not available for the other units of the Refuge Complex or for the Nanticoke protection area.

Threatened and Endangered Species

The Refuge Complex is noted for its abundance of rare, threatened, and endangered species. The Maryland and Delaware Natural Heritage Programs have documented more than 200 plant species and almost 70 animal species that are rare, threatened, or endangered. [See appendix C, "Rare Species in the Nanticoke River Watershed."] The Federal-listed species on the Refuge Complex include the American bald eagle, Delmarva fox squirrel (DFS) (*Sciurus niger cinereus*), shortnose sturgeon, sensitive joint-vetch, Canby's dropwort, swamp pink, northeastern beach tiger beetle, and five species of sea turtles. Blackwater NWR forests provide habitat for the largest aggregation and nesting population of American bald eagles along the Atlantic coast north of Florida, and for the Nation's largest protected population of DFS.

Delmarva fox squirrels.—Eastern fox squirrels occur along the Atlantic and Gulf Coastal Plains, from the Delmarva Peninsula in Maryland south to central Florida and west to the Mississippi River flood plain. A subspecies of the Eastern fox squirrel, the DFS was Federal-listed as endangered in 1967. It occurs in only four Eastern Shore counties in Maryland and in one location in Accomack County, Virginia. Within the study area and the Refuge Complex, DFS are found only in the Blackwater and Nanticoke rivers watershed. This subspecies formerly was found in southeastern Pennsylvania, Delaware, New Jersey and, probably, that part of the Delmarva Peninsula in Virginia.

The DFS inhabits open hardwood, hardwood–pine, and hardwood wetland communities, preferring mature stands of large hardwoods such as oaks (*Quercus* spp.), hickories (*Carya* spp.), walnuts (*Juglans* spp.), and beeches (*Fagus* spp.) that are interspersed with mature loblolly pine (*Pinus taeda*) (Moncrief et al. 1993, Bendel and Therres 1994). DFS also are found in deciduous swamps close to pine woodlands (Tesky, 1993). Fox squirrels are most abundant in open forest stands with little understory vegetation; they are not as abundant in stands with dense undergrowth. An ideal habitat is small stands of large trees interspersed with agricultural land (Allen, 1982, and Tesky, 1993). Contrary to this, Weigl (1989) and Paglione (1996) claim that large mature forest stands of loblolly pine and mixed hardwoods are essential for the existence of viable, stable populations of DFS. This is a prime example of the lack of information and conflicts in the literature on this species.

Much more local research must be conducted before definite habitat management recommendations can be made for this species. The size and spacing of pines and oaks are among the important features of fox squirrel habitats. The actual species of pines and oaks themselves may not always be a major consideration in defining fox squirrel habitat (Weigl, et. al. 1989, and Tesky, 1993). Fox squirrels are often observed foraging on the ground several hundred meters from the nearest woodlot. They also commonly occupy forest edge habitat (Dueser, et. al., 1988, and Tesky, 1993).

DFS habitat consists primarily of relatively small stands of mature mixed hardwoods and pines that have relatively closed canopies, open understories, and a high proportion of forest edge. Occupied areas include both groves of trees along streams and bays and small woodlots near agricultural fields. In some areas, particularly in southern Dorchester County, Maryland, occupied habitat includes areas dominated by mature loblolly pine located adjacent to marshes and tidal streams (Tesky, 1993).

In contrast to the gray squirrel (*Sciurus carolinensis*), the DFS often travels on the ground (Moncrief et al. 1993) and has been shown to prefer mature forests with a "minimum of underbrush" (Moncrief et al. 1993), closed canopies, open understories, and a high proportion of forest edge (Dueser et al. 1988). Authors have suggested that habitat for fox squirrels in general may be improved by leaving mature and large-crowned trees in managed forests, encouraging nut-bearing trees, and opening up the forest understory by burning or light grazing (Chapman et al. 1982, Engstrom et al. 1996). Fox squirrels have been found to prefer sites where understory closure is 30 percent or less (Allen 1982). Fire may reduce habitat suitability for the competing gray squirrel (Weigl et al. 1989).

Female fox squirrels normally produce two litters a year. They come into estrus in mid-December or early January and again in June. However, yearling females may produce only one litter, and poor food conditions may prevent some adult females from breeding. Females become sexually mature at 10 to 11 months of age. They usually produce their first litter when they are 1 year old. The gestation period of fox squirrels is 44 to 45 days. Earliest litters appear in late January, with most births occurring in mid-March and July. The average litter size is three, but litter size can vary according to seasonality and food availability. Tree squirrels develop slowly compared to other rodents. Eyes open when fox squirrels are 4 to 5 weeks old, and ears open at 6 weeks. Fox squirrels are weaned between 8 and 10 weeks but may not be self-supporting until 12 weeks. Juveniles usually disperse in September or October, but they may den together or with their mother the first winter.

Fox squirrels generally live up to 6 years in the wild, but have survived 13 years in captivity (Chapman and Feldhamer, 1982). Fox squirrels have two types of shelters: leaf nests and tree dens. They may have two tree cavity homes or a tree cavity and a leaf nest. Tree dens are preferred over leaf nests during the winter and for raising young. When den trees are scarce, leaf nests are used year-round. Forest stands dominated by mature to over-mature trees provide cavities and a sufficient number of sites for leaf nests to meet the cover requirements.

Fox squirrels may make their own den in a hollow tree by cutting through the interior; however, they generally use natural cavities or cavities created by northern flickers (*Colaptes auratus*) or redheaded woodpeckers (*Melanerpes erythrocephalus*). Crow nests have also been used by fox squirrels (Tesky, 1993). Overstory trees with an average d.b.h. of 15 inches (38.1 cm) or more generally provide adequate cover and reproductive habitat. Optimum tree canopy closure for fox squirrels is from 20 to 60 percent. Optimum conditions for understory closure occur when the shrub-crown closure is 30 percent or less (Allen, 1982; Tesky, 1993).

Food habits of fox squirrels depend largely on geographic location. In general, fox squirrel foods include mast, tree buds, insects, tubers, bulbs, roots, bird eggs, seeds of pines and spring-fruiting trees, and fungi. Agricultural crops such as corn, soybeans, oats, wheat, and fruit are also eaten (Allen, 1982; Chapman and Feldhamer,1982; Weigl, et. al., 1989; Tesky, 1993).

The range of fox squirrels in the eastern states has been greatly reduced in the past 100 years Chapman and Feldhamer, 1982; Tesky, 1993). Habitat reduction is one cause. The Delmarva Peninsula is undergoing rapid deforestation and forest modification due to accelerated residential and agricultural development, and intensive management techniques in commercial forests (Weigl, et. al., 1989; Tesky, 1993). One of the primary reasons for the decline of the endangered DFS is poor timber management techniques and accelerated rates of timber harvesting. As large trees are removed, so are much of the areas that provide the DFS with an open understory habitat. During this temporary loss of habitat, this subspecies is forced to compete with gray squirrels for food and nesting resources.
Logging practices that include harvesting all the big hardwoods and replacing them with stands of pure loblolly pine are also detrimental to DFS, since stands of pure species do not provide good fox squirrel habitat (Tesky, 1993). Another major cause of fox squirrel population decline is mange mite (*Cnemidoptes sp.*), along with severe winter weather (Chapman and Feldhamer, 1982; Tesky, 1993). The DFS population on Blackwater NWR, estimated at 550, appears to be stable.

Recovery Plan tasks specific to Blackwater NWR:

2.3 Field testing and defining applications for the Habitat Suitability Model;
4.1 Determining effects of timber management and other land use practices on the DFS;
4.2 Developing and refining guidelines for prescriptive habitat management for the DFS;
4.3 Developing and implementing guidelines for habitat management on public lands occupied by the DFS; and
4.4 Monitoring the outcome of prescriptive habitat management.

The figures below were selected from "Project Report, Analysis of Delmarva fox squirrel (*Sciurus niger cinereus)* benchmark population data (1991–1998)" Dr. Raymond D. Deuser, Utah State University, Logan, UT 84322-5210, January 19, 1999.

American bald eagle.—The Complex is known for its nesting and wintering concentrations of American bald eagles (*Haliaeetus leucocephalus*). Eagles use the expansive marshes, open waters, and upland areas to feed throughout the year. Dorchester County and Blackwater NWR support the highest nesting density of eagles in the state of Maryland and in the entire mid-Atlantic region. Migrating eagles from both the north and south use the Chesapeake Bay region as a wintering area. Annual midwinter American bald eagle surveys are conducted in January each year (table 3.14).

Red-cockaded woodpecker.—Once found on Blackwater NWR and Smith Island, the red-cockaded woodpecker (*Picoides borealis*) has not been sighted anywhere on the Refuge Complex since 1976, and is now believed extinct in Maryland.

Northeastern beach tiger beetle.—The northeastern beach tiger beetle (*Cicindela dorsalis*) is believed to have suitable habitat on Barren Island and Martin NWR; however, no specimen has been found to date.

Sea turtles.—Sea turtles like the endangered loggerhead (*Caretta caretta*), Atlantic green (*Chelonia mydas*), hawksbill (*Eretomochelys imbricata imbricata*), leatherback (*Dermochelys coriacea*), and Kemp's ridley (*Lepidochelys kempii*) are found occasionally in the waters surrounding Watts Island, Smith Island, Barren Island, Bishops Head Point, and Spring Island. No sea turtles nest on the Refuge Complex.

Table 3.14. Comparison of midwinter eagle surveys (Blackwater NWR and Maryland 1979-2001)

Year	*Bald Eagles*	*Golden Eagles*	*Year*	*Bald Eagles*	*Golden Eagles*
2001	97	2	1975	28	3
2000	93	2	1974	28	5
1999	121	1	1973	22	
1998	125	1	1972	22	2
1997	88	1	1971	25	2
1996	129	0	1970		
1995	72	2	1969	30	1
1994	53	1	1968	11	
1993	40	0	1967	11	2
1992	73	0	1966	11	2
1991	50	1	1965	9	
1990	81	1	1964	20	1
1989	38	1	1963	11	2
1988	29	2	1962	20	1
1987	29	2	1961	30	1
1986	36	1	1960	30	1
1985	36	0	1959	20	1
1984	49	1	1958	30	
1983	23	0	1957	30	
1982	38	1	1956	30	
1981	28	2	1954	25	1
1980	24	1	1953	35	1
1979	48	2	1952	30	1
1978			1951	35	
1977	38	3	1950	25	
1976	30				

Source: Blackwater NWR data and Annual Narrative Reports (unidentified eagles included with American bald eagles)

Benthic Organisms and Invertebrates

The abundance of SAV on the Refuge Complex indicates the value of the bottoms for benthic invertebrates. Although shallow water unvegetated substrate provides important habitat for many nekton species, this habitat has often been found to be relatively depauperate of benthic-oriented epifauna, compared to vegetated shallow water habitat (Heck and Thoman, 1984; Fonseca et al., 1996).

The protected interior shallow waters support a productive community of invertebrate species. Although some invertebrates have importance because of their commercial value, the ecological significance of most invertebrate communities lies in their contributions to the food web. They are a food source for fish, birds, reptiles, and mammals. The freshwater impoundments on Blackwater NWR provide significant populations of macroinvertebrates important for providing protein sources for migrating and wintering waterfowl.

The officially designated crabbing bottoms correlate well with the areas that now support or historically supported SAV. As previously discussed, the submerged vegetation provides cover that is especially attractive to molting blue crabs. Tangier Sound is particularly important as a migratory route for juvenile blue crabs moving northward from spawning grounds in the lower Chesapeake Bay. The commercial harvest of blue crabs is a major source of income for island residents. Smith Island is one of the most important soft-shell and peeler crab-producing areas in the Chesapeake Bay.

The 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, oyster populations in the vicinity of Smith Island have been decimated by the oyster diseases MSX and Dermo. The nearest charted oyster bar, Church Creek, is located approximately 1.5 miles west of Rhodes Point.

Finfish and Shellfish

The waters within the Refuge Complex support a wide array of fish species, and the associated marshes and estuaries are a spawning and nursery ground for commercial and sport fin and shellfish. Almost 300 species of fishes have been recorded in the Bay and its tributaries; about half are ocean fishes that enter the Bay to feed in warmer months, then return to the ocean. Ocean fishes are more likely to be found south of the study area. While most of these summer visitors spawn in the ocean, their larvae and juveniles enter the Bay at an early age to feed on the dense populations of invertebrates and small forage fishes. Atlantic menhaden (*Brevoortia tyrannus*) is probably the most abundant and most commonly seen fish in the Bay. The most abundant ocean species found in the shallows in the middle to lower parts of the Bay are three species of drum-spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), and silver perch (*Bairdiella chrysoura*).

Many fish species move into shallow waters in summer and out to deeper Bay waters in the fall. The most common Bay species found in shallow waters are the killifishes, anchovies, and silversides. Mummichogs (*Fundulus heteroclitus*) and banded killifish (*Fundulus diaphanous*) stay close to shore, with the mummichogs entering marshes to feed with the tides. Sheepshead minnows (*Cyprindon variegatus*) are also typical of shallow waters. Needlefish (*Strongylura nuvina*) prey on these small fish close to shore.

Bay anchovies (*Anchoa mitchilli*) and silversides [the Atlantic silverside (*Menidia menidia*), inland silverside (*Menidia beryllina*), and the rough silverside (*Membras martinica*)] are some of the most plentiful fishes in the Bay. Flatfish are common in the shallows, with the most likely in the central Bay area being the small, bony hogchokers (*Trinectes maculatus*), winter flounder (*Pleuronectes americanus*), and in more saline areas, summer flounder (*Paralicthys dentatus*), windowpane (*Scophthalmus aquosus*),and blackcheek tonguefish (*Symphurus plagiusa*). Older flatfish move to deeper waters or the ocean to spawn.

Fish typical of the deeper, open waters include schooling predator fishes, bottom-feeding fishes, reef-type fishes, and small foraging species. The adults of most species found in the shallows are found here, too. Large schools of menhaden and anchovies are preyed upon by schools of striped bass, bluefish, and seatrouts [spotted (*Cyroscion nebulosus*) and weakfish (*Cynoscion regales*)]; all four are avidly sought by sport fishermen. Species of commercial value include the white perch, alewife, river herring, American eel, striped bass, and American shad; the latter two being historically the two most important fish to swim the Nanticoke. Rockfish populations declined severely during the late 1970's and 1980's, a situation probably attributable to over-fishing, pollution, larval sensitivity to toxic metals and pesticides, and reductions in zooplankton that fed the young (USFWS, 1990).

At one time, the Nanticoke contributed 12 percent of the striped bass production in Maryland waters, which historically yielded approximately 10 percent of the entire Chesapeake Bay landings. During peak years, such as 1973 and 1976, the catch during March and April was 186,000 and 202,000 pounds, respectively, in Delaware. The striped bass population has rebounded somewhat following years of catch limits and a 5-year harvest ban. Maryland has imposed a fishing moratorium on shad since 1980. Shad catches are permitted in Delaware, but have been low.

The Refuge Complex also hosts diverse crabs, shrimp, clams, and oysters. The best known of these are the blue crab (*Callinecies sapidus*) and the American oyster (*Crassotrea virginica*). Both are found throughout the area, as is the less sought-after but commercially harvested soft-shelled clam (*Mya arenaria*). Commercially marketed pink (*Pinaius duorarum*), white (*P. setiferus*), and brown (*P. aztecus*) shrimps occur in the Bay, but not in sufficient quantities to harvest. Altogether, about 28 species of mollusks and 25 species of shrimp and crab are likely to be found in this portion of the Bay or its tributaries. Crabs are particularly abundant in the shallow waters around Tangier, Smith, and Bloodsworth islands in the warmer months.

It should be mentioned that fish and shellfish populations in the Bay have been affected by over-fishing of some species, declining acreage of SAV and estuarine marshes, and pollution. In addition, oyster populations have been decimated by two protozoan parasites: MSX (*Haplosporidium nelsoni*) and Dermo (*Perkinsus marinus*) (Lippson and Lippson, 1997). Also, the microbe *Pfeisteria piscidcida* threatens fish with lethal toxins in portions of the Bay, thought to be the result of over-fertilization of Bay waters by farming and livestock production (Warrick and Shields, October 3, 1997).

Anadromous Species

The Refuge Complex and Nanticoke protection area are both nursery and spawning habitat for eight species of Atlantic anadromous fish (species that spawn freshwater and live in the ocean) and nine species of migratory intercoastal or estuarine inland interjurisdictional fish. Every spring, anadromous herrings and shad enter the rivers and streams in large schools to spawn. The Nanticoke River now provides most of the spawning habitat. The waters of the upper Blackwater River, historically significant for spawning anadromous fish, are currently too salty and degraded due to the breach in the marsh that now joins the Blackwater River with the Little Choptank.

Shad species include American (white) shad (*Alosa sapissima*), hickory shad (*Alosa mediocris*) and gizzard shad (*Dorosoma cepedianum*). The closely related river herring species are alewife (*Alosa psuedoharengus*) and blueback (*Alosa aestivalis*). Once plentiful throughout the Chesapeake and harvested in great numbers until the turn of the century, the anadromous Atlantic sturgeon (*Acipenser oxyrhyncus*) is the largest fish to be found in the Bay and the waters of the Refuge Complex. The Atlantic sturgeon has a global ranking of G3 (very rare and local throughout its range), and the shortnose sturgeon is currently listed as endangered.

Striped bass (*Morone saxatilis*) typically spawn downstream of the Delaware state line on the Nanticoke River. However, eggs and larvae are transported into the Delaware portion by tidal currents and young stripers utilize the shoreline as a nursery area. The migratory intercoastal estuarine-inland interjurisdictional species include weakfish, red drum, blue fish, summer flounder, spotted seatrout, spot, Atlantic croaker, Atlantic menhaden, and shortnose sturgeon.

Catadromous Species

Elvers, or young catadromous American eels (*Anguilla rostrata*), hatch in the Sargasso Sea east of the Bahamas. They float with currents up into the Bay and its tributaries in great numbers to stay for 5 to 20 years before leaving to spawn in the ocean. American eel populations are declining, possibly due to lower water quality, lack of access to spawning habitats, and mortality in hydro-electric turbines. American eels historically have been harvested commercially on the Blackwater River.

Freshwater Species

Freshwater species that can tolerate low levels of salinity often can be found in shallow streams and protected coves of the larger estuarine rivers of the Refuge Complex. Yellow perch (*Perca flavescens*), the best known freshwater species in the Bay, has become acclimated to brackish water and behaves like the semi-anadromous white perch and gizzard shad.

Other freshwater fishes commonly found in somewhat to barely brackish water include brown bullhead (*Ameiurus nebulosus*); white catfish (*Ameiurus catus*); channel catfish (*Ictalurus punctatus*); white sucker (*Catostomus commersoni*); carp (*Cyprinus carpio*); goldfish (*Carassius auratus*) set free from fish tanks; golden shiner (*Notemigonus chrysoleucas*); silvery minnow (*Hybognathus regius*); spotted shiner (*Notropis hudsonius*); satinfin shiner (*Cyprinella analostana*); pumpkinseed (*Lepomis gibbosus*); bluegill (*Lepomis macrochirus*); black crappie (*Pomoxis nigromaculatus*); smallmouth bass (*Micropterus dolomieu*); largemouth bass (*Micropterus salmoides*); longnose gar (*Lepisosteous osseus*); chain pickerel (*Esox niger*); redfin pickerel (*E. americanus*) and eastern mudminnow (*Umbra pygmaea*). Of the many sportfish, the largemouth bass is by far the most important.

The Nanticoke River is the only drainage in Delaware where four species occur: the longnose gar, mottled sculpin, shield darter, and shorthead redhorse. Mottled sculpin are found only in a portion of Butler Mill Branch above Craig's Pond. Shield darters have only been collected in the upper portion of the Nanticoke near Bridgeville.

The marshes of Smith Island are permeated with tidal creeks which provide spawning, nursery, or feeding habitat for an abundance of finfish. The contiguous waters of Chesapeake Bay and Tangier Sound also support extensive fishery stocks. The Maryland Department of Natural Resources reports commercial fishery landings in Tangier Sound for 1992–1995. Those reflect only commercially sought; they do not reflect the recreational fishery.

The Smith Island – Tangier Sound area does have a significant recreational fishery, with sea trout, croaker, spot, bluefish, striped bass (*Morone saxatilis*), and summer flounder (*Paralichthys dentatus*) commonly being taken. Also, this data base does not cover the interior waters of Smith Island, or the large diverse assemblage of forage species and shallow water species such as minnows, killifish, and silversides, which are important prey items for larger species, such as striped bass.

Reptiles and Amphibians

The vast marshes and river swamps that compose the Refuge Complex offer ideal living conditions for at least 53 species of reptiles and amphibians. There likely are more, but surveys remain incomplete. Some of these creatures often are easily observed, such as a painted turtle basking on a log, while most are shy and elusive. These cold-blooded animals become torpid or dormant and inactive with the onset of winter. But with spring comes the constant sounds of frogs and toads and, throughout the long summer nights, the deep bass voice of the bullfrog resounds. Of those 53 species, the following are State-listed as rare, threatened, or endangered: the Eastern narrow-mouthed toad (*Gastrophryne carolinensis*), Carpenter frog (*Rana virgatipes*), Eastern tiger salamander (*Ambystoma tigrinum*), spotted turtle (*Clemmys guttata*), ground skink (*Scincella lateralis*), Eastern kingsnake (*Lampropeltis getula*), rough green snake (*Opheodrys aestivus*), Northern brown snake (*Storeria dekayi*), Northern redbelly snake (*Storeria occipitomaculata*) and the Northern copperhead (*Agkistrodon contoritrix*), the only poisonous snake found on the Refuge Complex.

The diamondback terrapin (*Malaclemys terrapin*) inhabits salt and brackish waters of the Eastern United States, from Cape Cod south to the Gulf coast of Texas. 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 near shore 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 (Roosenburg 1991). Diamondback terrapins inhabit the tidal marshes and creeks of Smith Island and other islands of the Chesapeake Island Refuges, and are harvested by the locals. The turtles have been observed nesting on the isolated upland hammocks. The diamondback terrapin is not Federal-listed as an endangered species; however, characteristics of terrapin life history render this species especially vulnerable to overfishing and habitat loss. These characteristics include low reproductive rates, low survivorship, limited population movements, and nest site philopatry.[6]

Waterfront development has been shown to directly reduce reproductive success in diamondback terrapins (Roosenburg 1991). Shoreline stabilization practices associated with near-shore development, such as wooden bulkheads, gabions, or rip-rap, prevent terrapins from reaching sites above the intertidal zone; the only viable terrapin nesting habitat. Because terrapins are philopatric (Roosenburg 1992), "hard" shoreline stabilization practices may eliminate entire breeding colonies. Other reptile species on Smith Island include box turtle (*Terrapene carolina carolina*), northern water snake (*Natrix sipedon*), and rough green snake (*Opheodrys aestivus*).

Mammals

Although the mammals of the Refuge Complex often are overlooked in favor of its more abundant and conspicuous bird life, the Refuge Complex hosts 38 species of mammals, including the endangered DFS.

Furbearers

The extensive wetland habitats of the Refuge Complex support healthy populations of native muskrats (*Ondatra zibethicus*), red and gray foxes (*Vulpes vulpes*), beavers, mink (*Mustela vison*), river otters (*Lutra canadensis*), and raccoons, as well as the exotic nutria. Most, but not all of these species are trapped on Blackwater NWR and the Nanticoke protection area, and provide a fur harvest which is a regionally important source of income. Beavers,

[6] a high degree of fidelity to nesting sites

often a problem species for many refuges, are not found on Blackwater, but do occur within the focus area. Furbearers are not managed on other units of the Refuge Complex.

The most prized furbearer on the refuge, the muskrat, is found in equivalent numbers in the United States only in the marshes of Louisiana. Blackwater muskrats are known to the mammalogist as the coastal, or Virginia, muskrat. The Virginia muskrat, which has two color phases, (1) brown or red, and (2) black, is about 2 feet long including the tail, and averages a little more than 2 pounds. In the Blackwater area, the muskrat is associated with the Olney three-square bulrush, which is the muskrat's primary source of food.

Muskrats live in dome-shaped houses or lodges that may be 5 or 6 feet in diameter and 3 to 4 feet in height. Houses are usually made from the three-square plants. To prevent an overpopulation of "rats" and consequent "eat-outs" of their habitat, trappers endeavor to keep the marsh trapped to a stable population level. The number of muskrats trapped at Blackwater NWR each year for the commercial trade has varied considerably in the nearly 67 years of trapping there. The catch has varied from approximately 1,000 to 26,000 a year. The years 1936 to 1940 were all high catch years ranging from 19,000 to 26,000 animals. During a peak population year as in 1938, five or more muskrats per acre were trapped in the Blackwater mashes.

Deer

Two species inhabit the Refuge Complex: Sika deer and white-tailed deer. While the former is found only on Blackwater NWR and the Nanticoke protection area, the latter is also found on Barren Island and the Bishops Head Divisions of the Island Refuges. Neither species is found on Susquehanna NWR or the other islands.

Overall deer herd health is monitored through the information collected at the check stations during refuge hunts. Each deer is sexed, aged, and weighed. Antler measurements are recorded for yearling bucks, and yearling does are examined for signs of fawning. Tooth wear and replacement indicate the age of each deer. Changes in yearling weights and yearling basal antler diameters will signal any long term shifts in deer herd health. Consistent declines in yearling weights and yearling basal antler diameter would indicate deer numbers too high for the habitat to support. Deer reproductive information is provided through examination of the yearling females and yearling males. Teat lengths indicate nursing, which reveal the productivity of fawn does. The diameter of the yearling buck antler base is directly correlated to the reproductive potential of the deer herd. Large diameters relate to higher deer herd productivity.

All deer are inspected for evidence of hemorrhagic disease, a viral disease spread by biting midges. Deer hemorrhagic diseases commonly appear in late summer and early fall. Deer that have survived hemorrhagic disease and are harvested in late November will exhibit hooves with sloughing tissue. These deer are still suitable for human consumption. The results of this disease survey are reported to the Southeastern Cooperative Wildlife Disease Study (SCWDS) in Athens, Georgia as part of a nationwide survey. Every 5 years, the SCWDS conducts a thorough necropsy of five randomly killed deer on the refuge. The necropsy focuses on the number of abomasal parasites, an indicator of herd health. This study is one of the oldest and most complete nationwide wildlife disease investigations.

Trends in deer abundance are commonly monitored using harvest estimates and age structure of the deer herd as previously described. Deer abundance is also monitored utilizing spotlight counts. Refuge staff are investigating the use of Forward-Looking Infrared (FUR) imaging to monitor deer abundance. FUR detects and differentiates thermal or heat sources and deer can be easily separated from the background heat under most circumstances.

Sika deer.—Sika deer inhabit marshes, swamps, and associated woodlands and agricultural fields. This species, a native of eastern Asia, became established after being released by Clement Henry on James Island during the early 1900's. Populations exist mainly in Dorchester County and on Assateague Island in Worcester County. Maryland DNR's sika deer management goal is to maintain this exotic species at current levels so that hunting opportunities are balanced with depredation issues across the lower Eastern Shore.

The popularity of sika deer hunting recently has increased. Non-residents and hunters from other areas of Maryland now travel to the lower Eastern Shore with hopes of taking a trophy 6-point sika. In 1999, more than 8,200 hunters pursued sika deer with firearms for an average of 4.2 days. About 4,500 muzzle-loader hunters stalked

sika deer for 3.2 days each, and almost 3,200 bow hunters tracked sika deer for an average of 7.2 days each (Maryland DNR Annual Report 1999–2000).

Sika deer management in Maryland changed for the 1998–99 hunting seasons. Only one antlered male could be taken during each hunting season (bow; firearm, muzzle-loader). Maryland DNR implemented this management change in the hope that more males would reach the prime age, while still allowing for appropriate population control.

Data collected in 1999 at big game checking stations by DNR Wildlife and Heritage Division staff indicated that the average field-dressed weight of a 1.5-year-old male sika deer was 53 pounds, while the +3.5-year-old males topped 80 pounds. Sika stags that were +3.5 years of age averaged 5.5 antler points, while 2.5-year-old deer had 4.1 points. Field-dressed yearling (1.5 years old) females averaged 45 pounds, with +3.5-year-old females weighing about 60 pounds. At Blackwater, the average yearling male sika deer field-dressed at 54 pounds, while the +3.5-year-old males weighed an average of 78 pounds.

The University of Maryland Eastern Shore, Fish and Wildlife Research Unit recently studied sika deer habitat, movements, and home ranges in Dorchester County and Blackwater NWR. Preliminary results indicated that average sika deer home ranges cover 2.5 to 3.6 square miles. Previous research conducted by DNR confirmed that sika deer have lower reproductive potential than white-tailed deer. Sika females tend to bear a single young while white-tailed females more than 1.5 years old usually bear twins. DNR research found that about 25 percent of sika female fawns were pregnant, while about 50 percent of white-tailed female fawns breed.

White-tailed deer.—Prior to the arrival of European immigrants, white-tailed deer inhabited all of Mary1and and eastern North America. Native Americans hunted deer during all seasons without bag limits. In Maryland, gray wolves and mountain lions preyed on white-tailed deer. The first European settlers in Maryland found ample white-tailed deer populations. Deer meat and hides provided them with food and clothing. As the colony prospered and human populations multiplied, unregulated market hunting and the destruction of habitat caused deer populations to decline drastically throughout the 1700's. With settlements expanding across the State during the 1800's, deer populations continued to drop, and mountain lions and wolves were exterminated.

By 1900, white-tailed deer only inhabited limited sections of far Western Maryland. Since the birth of wildlife management in the early 1900's, Maryland's deer population has steadily increased. State wildlife biologists, working hand-in-hand with private citizens, restocked the white-tailed deer to all available habitats in the State. Deer stocking efforts ended in the early 1960's. Early hunting seasons of the 1930's and 1940's prohibited the taking of antler-less deer, but soon deer populations expanded to allow more liberal seasons and bag limits. Currently, hunting antler-less deer is encouraged. On average, yearling white-tailed bucks Statewide carry 4.6 antler points and weigh 105 pounds field dressed, while 3.5-year-old white-tailed bucks field dress at about 145 pounds and sport 8.4 points.

Table 3.15. Deer harvest summary (Blackwater NWR)

Year	*Deer*	*Youth*	*Muzzle-loaders*	*Shotguns*	*Species Total*	*Total Deer*	*Total Hunters*	*Total Acres (est.)*	*Shotgun Days*	*Muzzle-loader Days*	*Youth Days*
1985	WT			20	20	22	76		2		
1985	Sika			2	2						
1986	WT			21	21	41	118		2		
1986	Sika			20	20						
1987	WT			15	15	64	160	3,400	2		
1987	Sika			49	49						
1988	WT			15	15	48	154	3,400	2		
1988	Sika			33	33						
1989	WT			17	17	79	98	3,200	2		
1989	Sika			62	62						
1990	WT			4	4	38	142	3,400	2		
1990	Sika			34	34						
1991	WT			9	9	62	235	4,175	2		
1991	Sika			53	53						
1992	WT			20	20	94	260	4,175	2		
1992	Sika			74	74						
1993	WT			20	20	96	289	4,880	2		
1993	Sika			76	76						
1994	WT			19	19	62	327	4,880	2		
1994	Sika			43	43						
1995	WT			29	29	99	315	6,680	2		
1995	Sika			70	70						
1996	WT		7	15	22	122	668	8,000	2	2	
1996	Sika		25	75	100						
1997	WT	2	20	28	50	203	833		4	2	1
1997	Sika	3	37	113	153						
1998	WT	1	15	11	27	136	782		4	2	1
1998	Sika	1	22	86	109						
1999	WT	4	11	10	25	170	918		4	2	1
1999	Sika	1	33	111	145						
2000	WT	4	19	24	47	228	999	17,000	4	2	1
2000	Sika	5	29	147	181						

1984 Annual Narrative Report (p.1) states "There has been no hunting on the refuge since the last deer hunt in 1972." Hunting resumed in 1985.

Exotic and Invasive Species

Executive Order No. 13122 authorizes and directs the Service to protect native wildlife and their habitats on national wildlife refuges from damage associated with invasive and injurious species, including damage related to migratory birds.

Nutria.—Nutria are an exotic, invasive, semi-aquatic South American rodent introduced on Blackwater in 1943. Because they are a foreign addition to Maryland's natural communities, no inherent biofeedback mechanisms exist to naturally control their populations. Consequently, successive population increases and range expansions have established populations in at least eight counties on the Eastern Shore. Populations on Blackwater NWR estimated at fewer than150 nutria in1968 have grown to an estimated 35,000–50,000 today.

Loss or degradation of Maryland's coastal wetlands has reached alarming proportions. It is estimated that 65 percent of those fragile ecosystems have been lost since the 1700's. Nutria digging behavior damages or destroys the existing root mat that binds and secures structural components of functional marshlands. When this fibrous network is compromised by nutria activity, emergent marsh is quickly reduced to unconsolidated mudflats. These areas in turn are highly susceptible to erosion, and eventually convert to open water. While nutria are not the sole reason for marsh loss, they have been implicated as the catalyst that has greatly accelerated losses during the last decade.

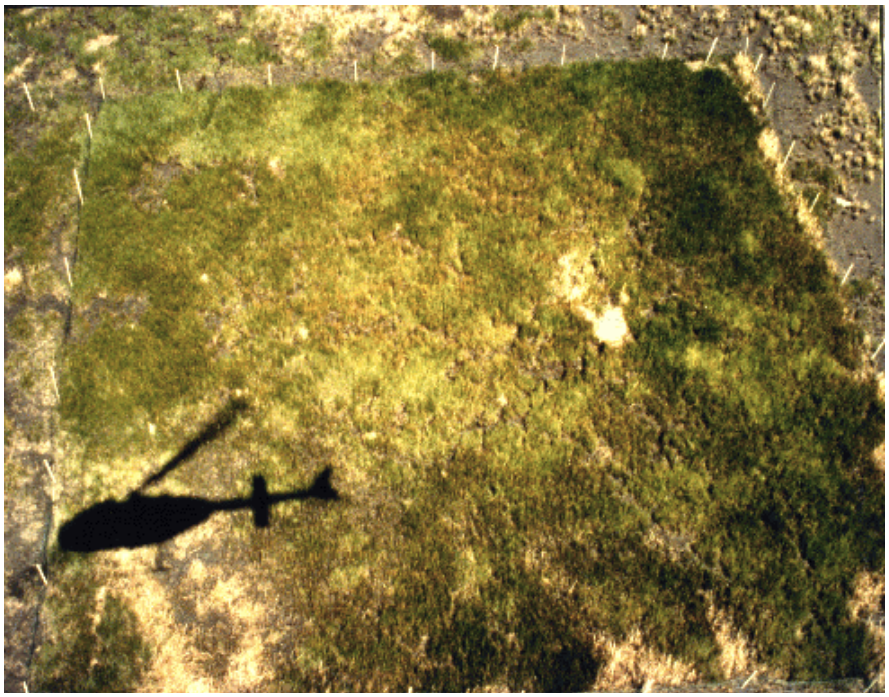


Figure 3.10. One year of nutria exclusion from marshes

Fourteen other states also are experiencing, in varying degrees of severity, the problems associated with the nutria populations established in Maryland. Likewise, localized harvest schemes do not adequately meet most management concerns. No pragmatic, effective means now exists to meet these challenges.

Nutria display phenomenal reproductive characteristics. As a result of these capabilities, conventional commercial or recreational harvest has proven ineffectual in reversing population growth trends. Although nutria are relatively easy to harvest in large numbers by experienced trappers, it has become apparent that this, in and of itself, is not enough.

Successful eradication efforts in Great Britain have demonstrated that it is how, when, and where nutria are harvested that contributes to their ultimate demise. Understanding behavioral and reproductive traits, and how they change in response to intense harvest pressure, will allow researchers to identify weak links or exploitable behavioral manifestations. This, in turn, will enable control personnel to develop harvest strategies and techniques that capitalize on those idiosyncrasies, thus ensuring maximum reduction values.

Mute swans.—Native to Europe, mute swans were brought to this country in the late nineteenth century to grace the ponds of country estates. The mute swan is an introduced species in Maryland. From the escape of five captive swans from a Talbot County waterfront estate in 1962, Maryland's feral mute swan population has increased to 3,955 birds in 1999 (figure 3.11). The 1999 mute swan estimate was 46 percent greater than the 2,100 swans counted during the 1996 survey.

The 1999 mute swan population included 594 breeding pairs; 2,115 nonbreeders, and 646 young (cygnets). Mute swans reside primarily in estuarine river habitats with smaller numbers on inland lakes and ponds. The largest number of mute swans occurs in the lower Chester River south to the Little Choptank River along the Eastern Shore. Lesser numbers of mute swans were observed in lower Eastern Shore tributaries, with 1ocal concentrations in the vicinity of Hoopers and Bloodsworth Islands and Western Shore tributaries, like the Patuxent River. Mute swans are not federally protected. However, by virtue of their genetic link to the family of swans, they are given State protection in Maryland as wetland game birds. Population growth and range expansion of this species has increased the number of swan-related problems.

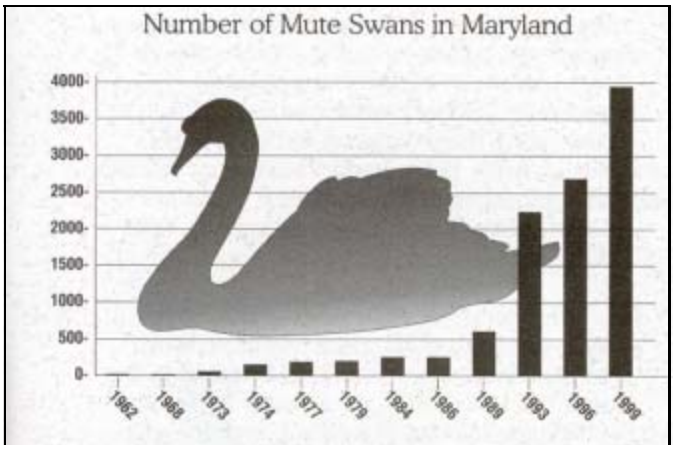


Figure 3.11. Mute swans in Maryland

Although valued for their aesthetic qualities, mute swans pose a potential ecological threat to certain native species of wildlife. Since this species did not evolve in the Chesapeake Bay region and develop genetic mechanisms to coexist with native bay wildlife, conflicts between mute swans and native wildlife have emerged. Of greatest concern is the impact of mute swans on native tundra swans, which winter in Maryland. Mute swans have been observed driving tundra swans from preferred feeding and resting habitats. Since the mid-1970's, Maryland's wintering tundra swan population has declined by about 30 percent. However, research is needed to tell whether this decline is related to increased competition from mute swans.

In the early 1990's, a large molting flock (>600) of mute swans prevented colonial water birds (terns and skimmers) from nesting on Barren Island. The swans used the islands for loafing, and trampled the nests, eggs, and chicks of the terns and skimmers. Those swans also displaced nesting Forster's and common terns, declining species in Maryland. In response, personnel from the Maryland DNR and Refuge Complex reduced the mute swan flock in this area to alleviate the problem.

In other areas of the State, mute swans have also killed mallard ducklings, Canada goose goslings, and cygnets belonging to other mute swan pairs. However, they appear to tolerate adult birds of other species nesting nearby. The Refuge Complex has zero tolerance for mute swans, and takes appropriate actions to keep swans from becoming established on Service lands and waters. Often, however, Refuge Complex staff cannot control swans if they are on State-owned waters.

Citizens have complained that mute swans reduce the availability of submerged aquatic vegetation to native wildlife, reducing recreational crabbing and fishing opportunities. Presently, Maryland's mute swan flocks consume an estimated 9 million pounds of submerged aquatic grasses annually. In some instances, concentrations of mute swans have over-grazed bay grasses, eliminating habitat for crabs, fish; and other wetland-dependent species.

Some mute swans are aggressive, and will attack humans, especially small children, in defending their nest and young. Although the potential for injury is low, their territorial behavior is a nuisance and renders some land or water areas inaccessible to people during the breeding season.

The mute swan is a highly visible species that provides aesthetic values to some people. However, the growth of the feral mute swan population must be managed to prevent harm to native species and habitats. In the absence of population control measures, we expect the number of mute swans in Maryland to continue to increase. Eventually, this exotic species could occur throughout the Chesapeake Bay region and cause additional ecological harm and problems for humans.

In response to public interest, the Governor appointed a citizens advisory committee in 1999 to identify pubic concerns and suggest strategies related to the management of mute swans in Maryland. The project leader for the Refuge Complex is a member of the committee. We hope recommendations now pending will be implemented to keep the Bay's mute swan population from expanding to uncontrollable numbers.

Phragmites.—Phragmites is an aggressive colonizer that has displaced other marsh species in many other parts of the Chesapeake Bay. Also known as "common reed", it is a large coarse perennial grass. Phragmites, like loosestrife, reduces the diversity of plant and wildlife species in the wetlands (Cross and Fleming 1989). Although scattered clumps provide cover for small mammals and birds, it usually forms large, monotypic, impenetrable stands that provide little value for wildlife. The exact abundance and current rate of spread of Phragmites on refuge lands is unknown; but it is documented that it is increasing in abundance and distribution. Phragmites has a thick stalk that can reach 13 feet in height, and a large, plume-like flower. The plant reproduces both by seeds and extension of long creeping rhizomes.

Phragmites is currently not being treated except in the impounded wetland systems; thus, it has great potential to spread to natural systems and seriously destroy natural freshwater wetland ecosystems if not properly controlled (Cross and Fleming 1989). Rodeo™ is one of the most environmentally acceptable herbicides used for treatment. When used at the recommended rates and in conformance with the procedures and methods described above, it has very minor effects on the environment. Biological control is rarely a practical option for controlling Phragmites, because those organisms known to feed on this plant cause only incidental damage, with a few rare exceptions (Cross and Fleming 1989). The post-treatment burning removes the mats of dead vegetation, allowing the native forms of vegetation to quickly recolonize infected areas.

The approximate acreage of Phragmites on the Refuge Complex is now unknown, but conservative estimates from aerial photographs and anecdotal information suggest that several thousands of acres are infested with this exotic species. Efforts to accurately map acreage are presently underway. This highly invasive plant is readily apparent in most of the wetland systems, and can be found throughout Blackwater NWR, the Island Refuges, and to a lesser extent, the Nanticoke protection area. Susquehanna NWR has no Phragmites.

Phragmites is now treated with Rodeo at the prescribed rate of 6 to 10 lbs./acre, using hand and aerial application. As previously noted, treatments are presently limited to infestations within the freshwater impoundment system. Size, accessibility, and proximity of Phragmites to other vegetation or wetlands dictate the most appropriate application technique. On small beds, backpack sprayers are used. If areas are very large or are inaccessible from the ground, aerial spraying by an experienced helicopter pilot is used. A marker system is placed before flying transects to maintain a reference point during refilling. Infrared photographs of treated areas are viewed to locate missed spots. Equipment used for aerial spraying is free of leaks and has complete cut-off capabilities to prevent treatment of nontarget areas. The cost of aerial spraying averages approximately $40 per acre.

As well as chemical control, other techniques include physical treatments like mowing, discing, flooding, draining, and burning, although these have not proven very successful when used alone. Once a stand has become established, the key to controlling the plant involves destroying the underground rhizome system. The rhizome mat can often be more than 3 feet thick, and one can imagine how difficult and impractical it would be to mechanically remove the rhizome mat. Multiple treatments, therefore, often are required to effectuate control.

The most practical method is the spraying of glyphosate herbicide when plants are actively growing and at mid-to-full bloom (late August or September, but before a killing frost). The plants die within 6–8 weeks, and are then burned or mowed to eliminate shading of preferred vegetation. Burned areas regenerate in more favorable vegetation quicker than unburned areas (Jones 1995). For best results, the same area is sprayed in two successive years, then spot-treated in succeeding years to prevent reestablishment. A toxic chemicals application permit is needed from the Maryland Department of the Environment's Industrial Discharge Permits Division to spray Phragmites in wetlands.

Gypsy moth.—The gypsy moth (*Lymantria dispar L.*) is one of the most notorious pests of hardwood trees in the Eastern States. Brought to Massachusetts from Europe in 1869 to interbreed with silkworms, this devastating forest defoliator can be found in all Maryland counties today. The larvae prefer hardwoods, but may feed on several hundred different species of trees and shrubs. In the East, the gypsy moth prefers oaks, apple, sweetgum, speckled alder, basswood, gray and white birch, poplar, willow, and hawthorn, although other species are also affected.

The effects of defoliation depend primarily on the amount of foliage that is removed, the condition of the tree at the time it is defoliated, the number of consecutive defoliations, available soil moisture, and the species of the host. If less than 50 percent of their crown is defoliated, most hardwoods will experience only a slight reduction in radial growth. If more than 50 percent of their crown is defoliated, most hardwoods will refoliate or produce a second flush of foliage by midsummer. Healthy trees can withstand one or two consecutive defoliations of greater than 50 percent. Trees that have been weakened by previous defoliation or been subjected to other stresses, such as drought, are frequently killed after a single defoliation of more than 50 percent.

Trees use energy reserves during refoliation and eventually are weakened. Trees weakened by consecutive defoliations are vulnerable to attack by disease organisms and other insects. For example, the Armillaria fungus attacks the roots, and the two-lined chestnut borer attacks the trunk and branches. Affected trees will eventually die 2 or 3 years after they are attacked. Although not preferred by the larvae, pines and hemlocks are subject to heavy

defoliation during gypsy moth outbreaks and are more likely to be killed than hardwoods. A single, complete defoliation can kill approximately 50 percent of the pines and 90 percent of the mature hemlocks (McManus, 1999).

Natural predators, parasites, and diseases that normally feed on the egg masses and caterpillars are not as prevalent in the United States or are not as effective as in their native habitats. However, natural enemies may play an important role during periods when gypsy moth populations are sparse. Natural enemies include parasitic and predatory insects such as wasps, flies, ground beetles, and ants; many species of spider; several species of birds such as chickadees, blue jays, nuthatches, towhees, and robins; and approximately 15 species of common woodland mammals, such as the white-footed mouse, shrews, chipmunks, squirrels, and raccoons.

Diseases caused by bacteria, fungi, or viruses also help contribute to the decline of gypsy moth populations, especially during periods when gypsy moth populations are dense and are stressed by lack of preferred food sources. Wilt disease caused by the nucleopolyhedrosis virus (NPV) is specific to the gypsy moth and is the most devastating of the natural diseases. NPV causes a dramatic collapse of outbreak populations by killing both the larvae and pupae. Larvae infected with wilt disease are shiny and hang limply in an inverted "V" position.

Weather may also have significant effects on the survival and development of gypsy moth life stages regardless of population density. For example, temperatures of -20 °F (-29 °C) lasting from 48 to 72 hours can kill exposed eggs; alternate periods of freezing and thawing in late winter and early spring may prevent the overwintering eggs from hatching; and cold, rainy weather inhibits dispersal and feeding of the newly hatched larvae and slows their growth.

A number of more direct tactics have the potential to minimize damage from gypsy moth infestations and to contain or maintain gypsy moth populations at levels considered tolerable. These tactics include monitoring gypsy moth populations, maintaining the health and vigor of trees, discouraging gypsy moth survival, and treating with insecticides to kill larvae and protect tree foliage (McManus, et. al. 1999).

Since 1991, Region 5 refuges have requested and received forest pest management funding from the USDA Forest Service (USFS) under the authority of the Cooperative Forestry Assistance Act of 1978 (P.L. 95–313) and the Forest Stewardship Act of 1990 (P.L. 101–624). These acts recognize the need for public and private cooperation in combating forest insects and disease and the need for federal leadership and financial assistance on all forest lands. Since 1993, Blackwater NWR, has been plagued with repeated infestations of Gypsy moths. As soon as infestations were detected, the refuge requested assistance from the USFS North East Area State and Private Forestry. USFS personnel have since provided technical and hands-on assistance by performing annual egg mass surveys and population estimates, making treatment recommendations, assisting with funding requests and contract preparation, providing oversight on treatment projects, conducting follow-up aerial defoliation surveys and developing detailed reports of the initial findings and treatment efficacy.

However, the most valuable assistance provided by the USFS is the actual funding for the detection and control of forest insects and diseases. Blackwater NWR has applied for and received forest pest management funding every year since the initial outbreaks in 1993, with the exception of 1999, when no treatment was required. Without their support over the years, it is highly likely that the refuge may have lost a significant portion of its DFS habitat. Over the past 8 years, with the help of the USFS, 12,744 acres have been treated to suppress growing populations of gypsy moth larvae (see table 3.16, below). Since many of those acres received double applications, the actual area treated equals 19,655 acres. The most common and effective method of controlling Gypsy moth populations is aerial application of the biological insecticide *Bacillus thuringiensis* (B.t.). Gypcheck, a synthetic insecticide that mimics a naturally occurring virus, has also been used on the refuge, with somewhat unsubstantiated results.

Table 3.16. Gypsy moth control (Blackwater NWR) 1993-2001

Year	*Control Agent*	*Treatment Area (ac)*	*No. of Applications*	*Acres Treated*	*Cost*
1993	Gypcheck	150	2	300	$6,000
1994	B.t.	1,843	1	1,843	$25,376
1995	B.t.	1,837 846	2 1	4,520	$46,000
1996	B.t.	896	2	1,792	$19,900
1997	Gypcheck	1,329	2	2,658	$51,000
1998	Gypcheck	2,087	2	4,174	$75,000
1999	N.A.				
2000	B.t.	608 2,878	2 2	1,216 3,152	$24,000 $87,460
2001	B.t.	270	1		
TOTAL		**12,744**		**19,655**	**$334,736**

Throughout the history of Blackwater NWR, the lack of forest management, coupled with other endemic processes, has had significant impacts on forest health. Their increased stress and decreased vigor leave our forests susceptible to infestations of gypsy moths and other forest insect pests and diseases. Using sound forest management, we can significantly improve forest health and vigor, while providing quality habitat for Federal trust species and other wildlife. Over time, as forests improve on the refuge, their susceptibility to the variety of stress-related killing agents will decrease, thus, reducing our reliance on insecticides to control forest pests. However, the use of insecticides will never be eliminated completely, due to its lower cost and greater effectiveness.

Resident Species

Resident Canada geese.—The phrase "resident Canada geese" refers primarily to local breeding Canada geese that nest and raise their young in Maryland. Resident Canada geese do not migrate to northern Canada, but remain year-round in southern Dorchester County. All Canada geese, regardless of their migratory status, are technically classified as migratory birds, and are managed under the Migratory Bird Treaty Act (MBTA). The distinction between resident geese and migratory geese often is confusing to the public. The nearest comparison is between the domesticated park mallard, or marina mallard, and the wild migratory mallard; both are generally the same in appearance, yet behaviorally quite different. The MBTA recognizes those distinct behavioral differences among mallards, and efforts are ongoing to amend the MBTA to recognize similar differences between resident and migratory Canada geese.

At Blackwater NWR, banding programs conducted by refuge staff and Maryland DNR staff have been underway for the past 10 years to determine whether geese are resident or migratory. Both neck collars and leg bands have been used, and investigations have verified that the birds at the refuge are locally raised geese that subsequently stay year-round and raise their young, which become breeders and raise even more young. The resident Canada geese are now adversely affecting the purpose(s) for which the refuge was established.

Present-day populations originated from birds that were released or escaped from private waterfowl collections or hunting clubs between 40 and 50 years ago, and from birds that were moved to the refuge from other areas. These non-migratory stocks of geese probably include a mix of several different subspecies, including the giant (*Branta canadensis maxima)*, western (*B.c. moffitti),* North Atlantic (*B.c. canadensis),* and interior (*B.c. interior)* races. The refuge's resident goose population grew from only about 350 birds in 1989 to more than 5,000 in 1998, and increased by almost 70 percent in just the last breeding season. That increase may be the result of the exploitation of man-made food resources, e.g., clover, corn, winter wheat, buckwheat, and other agricultural crops planted on the refuge resulting in improved nutritional health and thus, better reproductive success and gosling survival; few predators; and almost complete protection from harvest by hunting except when birds fly to private lands.

The resident Canada geese's feeding and breeding behavior, habitat preference, and adaptability to man-made environments create situations in which Canada geese and humans conflict. Resident Canada geese feed on clover, grasses, and cereal grains, exactly the types of crops that migratory Canada geese need to survive the winter. Resident Canada geese also favor short, manicured grass, particularly near a water source, for loafing and feeding.

Refuge dikes, important for managing water levels for migratory waterfowl, shorebirds, and other marsh and water birds, provide just such feeding and loafing areas which resident birds quickly denuded of vegetation causing erosion and dike failure.

Another indicator of the increasing problems with resident Canada geese is the number of complaints received by USDA Wildlife Services Offices. In 1993, their Annapolis office received no complaints from Dorchester County residents. In 1994, 1995, 1996, 1997, and 1998, complaints increased to 3, 5, 4, 4, and 6, respectively. While the number of complaints is relatively low, it is interesting to note that, while only $300 in economic damage was noted from 1993 through 1997, $34,000 in damages to private agricultural crops was noted in 1998. Damages sustained by the refuge during these years were not included in these statistics.

Resident Canada geese nest from March through June. Eggs take approximately 30 days to hatch. Parent geese are very protective and aggressive in defense of young and nest. This aggressive behavior can potentially lead to attacks on human visitors, particularly visitors along the Wildlife Drive, where geese sometimes nest. The refuge is not open to the special Maryland September hunting season for resident Canada geese, since waterfowl hunting would interfere with other management objectives and refuge purposes.

However, even if the refuge were open to public waterfowl hunting, control of resident Canada geese would be extremely minimal based on the reports of harvest statistics obtained from Edwin B. Forsythe NWR in New Jersey and Tudor Farms, Inc., a 6,000-acre private hunting preserve adjoining the refuge. At Edwin B. Forsythe NWR, 762 hunters, hunting 3,866 hours during three consecutive state seasons, took only 413 geese from the refuge impoundment system. Despite considerable hunting pressure at Tudor Farms, Inc., very few geese were taken during the 10-day State season, and the landowner was forced to eventually acquire a depredation permit from the FWS.

Statewide, the resident Canada goose population has increased from 25,000 in 1989 to 90,000 in 1998. (Maryland's population objective for resident Canada geese is 30,000). The direct and indirect results of this population explosion are adversely affecting the primary purpose for which the refuge was established. Exclosures built by refuge staff in the spring of 1999 clearly demonstrate that resident geese are seriously impacting the refuge's natural marsh vegetation, which is already stressed by sea-level rise, salt water intrusion, and overgrazing by nutria, and are contributing to the loss of wetlands important to the Chesapeake Bay ecosystem.

Studies and investigations by researchers Haramis and Kearns in the Patuxent Marshes, Maryland; May and Kangas in Kenilworth Marsh, Washington, D.C., and Nichols on the Maurice River, New Jersey, substantiate similar destruction of natural marsh vegetation by resident Canada geese. A study at Bombay Hook NWR also statistically validated that resident geese are significantly affecting natural vegetation in moist soil impoundments. While not statistically validated at Blackwater NWR, observations by refuge staff during scheduled vegetation transects also documented impacts on moist soil vegetation in impoundment systems important for producing food resources for migratory waterfowl. Likewise, resident Canada geese are causing significant damage to agricultural crops planted to provide critical forage for migrating and wintering waterfowl.

Increasing damage has been documented by refuge staff during the past 10 years throughout the refuge, but particularly on the 240 acres of crops within the Key Wallace corridor, the area from the Little Blackwater River to State Highway 335. In 1999, for example, refuge staff documented the total destruction of 47 acres, almost half, of the refuge's annual corn crop, and 126 acres of ladino clover. Also, observations by refuge biologists validate that resident Canada geese concentrate around the remaining water during summer impoundment drawdowns. The resulting concentrations of fecal droppings in these stagnant pools, when the temperatures are high, create excellent mediums for degraded water quality, and increase the potential for human and avian diseases transmitted by fecal material.

For example, during a 1998 survey conducted by the National Wildlife Health Research Center (NWHRC), 16 percent of 37 resident Canada geese studied from Blackwater NWR were DVE (duck virus enteritis or duck plague) positive. There is also increased concern regarding transmission of diseases such as cryptosporidiosis, giardiasis, and chlamydiosis. Because of this potential problem, Region 5 funded investigations by NWHRC and New Jersey Division of Fish, Game and Wildlife in 1999 to evaluate threats to human health posed by resident Canada geese in Rhode Island, New Jersey, and Virginia.

Resident gosling production on the refuge exceeded 2,000 in 1998, and resulting damage to refuge habitats was significant despite the expenditure of at least one full staff-year of effort and thousands of dollars for harassment or scare devices. When these habitats are destroyed or their productivity is significantly reduced, the refuge lacks enough wintering habitat to support its migrating and wintering waterfowl; thus, the refuge cannot achieve the purpose for which it was established. The refuge population of resident geese is also expanding to private lands, and it is not uncommon to see flocks of nonbreeding geese flying almost anywhere south of Route 50 during the spring and early fall. These nonbreeders join with breeders and their fledgling young in the early fall cause extensive damage by overgrazing and polluting private agricultural fields, alfalfa and hay meadows, lawns, golf courses, and other areas.

Other species.—Bobwhite quail and the eastern wild turkey are common on Blackwater NWR and in the Nanticoke protection area, but are not found on any of the Island Refuges.

Purple loosestrife.—Purple loosestrife, a beautiful but aggressive invader, arrived in eastern North America in the early 1800's. Plants were brought into the United States by settlers for their flower gardens, and since has spread to much of the nation. Purple loosestrife was first observed on the Refuge Complex at Blackwater NWR in 1996. Thirty-five plants were pulled and incinerated. Treatment has been continued by manually pulling up and incinerating the few plants that are observed or by spraying glyphosate (as Rodeo, the formulation approved by the U.S. Environmental Protection Agency for use in wetlands) at the prescribed rate.

The best time to control purple loosestrife is in late June, July, and early August, when it is in flower and plants are easily recognized, and before it goes to seed. Once flower petals start to drop, the plant begins to produce seed, and care will be taken to avoid seed dispersal. It should be noted that biological control using *Galerucella*, *Hylobius*, and *Nanophyes* beetles is not currently being used primarily because of the lack of plant density. Biological control is preferred in areas of high plant densities and severe infestations on relatively large acreage where manual and chemical controls are ineffective and may contribute to the problem.

Other noxious weeds.—The State of Maryland mandates control of Canadian thistle and Johnson grass. Efforts to control these noxious weeds have been ongoing at Blackwater NWR for many years. However, each year some spot treatment with Roundup on between 10 and 15 acres is required to maintain control.

Cultural and Historical Environment

Paleoenvironment

Millis, et. al (2000) described the paleoenvironment as follows. The more than 11,000 years of human occupation of the Atlantic Slope is divided into two broad climatic periods. The earlier period spans from 13,000 to 10,000 B.P. and is the ice age, or Latest Pleistocene. The later period began at 10,000 B.P. and is referred to as the Holocene. Although the Chesapeake Bay region was never covered by the Canadian Laurentide continental glacier, early inhabitants assuredly felt its effects. At times the glacial front was as close as northern Pennsylvania, and glacial outwash flowed down the Susquehanna River (Schuldenrein 1994).

During the Pleistocene, the Delmarva Peninsula weather could have been cold because of proximity to the glaciers. Air supercooled by its passage over the glaciers (katabatic winds) would have settled into the region at times, bringing extremely rigorous weather. The Maryland Eastern Shore region lies between the zone of active Pleistocene glaciation, which is approximately 160 miles (257.50 km) to the north, and the zone of minimal glacial effects, which begins approximately 230 miles (370.15 km) to the south (Keel 1976). Custer (1989) places the Delmarva Peninsula region south of periglacial activity, which he defines as restricted to the area above the fall line in Maryland. The study area thus experienced some of the marginal effects of glaciation, such as permafrost and lowered sea level, without undergoing the scraping away of soils and vegetation, as in fully glaciated landscapes.

Recent studies of late Pleistocene climate around the north Atlantic basin have shown it to be somewhat different from that of the world at large. Pleistocene conditions ended in most areas of the world around 13,000 B.P. (Delcourt and Delcourt 1983, 1985; Watts 1979, 1980). However, due to the wasting of the Laurentide ice sheet, near ice-age conditions reappeared once in northeast North America (Broecker and Denton 1990; Fitting 1974). This cold episode

followed 11,000 B.P., when runoff from the melting glacier suddenly shifted from the Mississippi River to the St. Lawrence River (Broecker and Denton 1988). The rush of cold fresh water from the St. Lawrence River disrupted the Gulf Stream's warm northward current, returning the North Atlantic basin to near ice-age conditions for about 700 years. It was registered as a somewhat cooler period in most of the world, but was quite cold in northeast North America. It should be thought of as resembling the Little Ice Ages of the last 2,000 years (Denton and Karlen 1973), rather than a reappearance of full glacial conditions. During the Holocene, the glacier retreated and finally disappeared.

Over 23,000-year periods, wobbling of the Earth's axis of rotation around the north pole appears to have been the greatest influence on the changing climate. The effects were the most dramatic in the Northern Hemisphere. During the ice ages, the North Pole tilted away from the Sun in the fall (Kukla 1975; Kukla and Gavin 1992). The tilting reduced the supply of energy from the Sun reaching the Northern Hemisphere by 7 percent, resulting in dark falls that allowed the glaciers to grow each year and eventually expand to immense proportions (Davis and Seller 1994; Kutzbach and Guetter 1986).

Also during the ice ages, seasonal diversity diminished, producing an equitable climate of permanent poleward winter and permanent equatorial summer, although the summers were cool like a modern spring. The equitable seasons of the Pleistocene produced a mosaic vegetation, a species-diverse, patchy arrangement of plant and animal communities. During the Early to Middle Holocene interglacial, the tilt of the Earth shifted toward the Sun in summer and away in winter (Davis and Sellers 1994; Bryson 1994). This resulted in bright, hot summers and dark, cold, dry winters.

A major sea level transgression that eventually formed the modern Chesapeake Bay began about 18,000 years ago. The impacts of this transgression began to be felt at Blackwater NWR about 4,000 years ago, at which time tidal marshes began to form in Blackwater River. Prior to the formation of marshes, most of Blackwater NWR was a freshwater ecosystem with large tracts of nontidal freshwater swamps formed by low-drainage soils. After marshes formed, much of the area evolved from tidal freshwater marsh to brackish marsh, and now even to salt marsh. Presently Blackwater NWR marshes stand out among all other Chesapeake Bay marshes in that they are converting to open water. This change is most likely a result of an array of natural and man-made disturbances.

Historical Overview

Early settlement of Maryland by Euro-Americans began in 1634, when two shiploads of British immigrants established Saint Mary's City at the mouth of the Potomac River. The settlement was on land granted on the north side of the Potomac to the first Lord Baltimore, George Calvert. Calvert's son Cecil oversaw the settlement of the colony. Generous land grants were made to all settlers who paid their way across the Atlantic, while those who could not pay worked as indentured servants for a set number of years, after which they could purchase land (Kellock 1962:6). George Calvert had converted to Catholicism and it was his dream that his colony promote religious tolerance. His children carried out his dream, and the colony of Maryland attracted a diverse population from England, Wales, Scotland, Ireland, and France.

At the time of European contact, Algonquin-speaking tribes inhabited the peninsula (Davidson et al. 1985). European conquest brought an end to the Late Woodland lifestyle, although many relics of the material trappings, belief systems, and social structure of classic Late Woodland society lingered into the eighteenth century in parts of the East. Four Native American groups on the Eastern Shore were recognized by the Maryland colonial government: the Choptank, Nanticoke, Pocomoke, and Assateague. Treaties were signed by the government in the mid-seventeenth century to provide specific lands for the exclusive use of these groups and establish procedures for resolving conflicts (Davidson 1982). John Smith and John White, two early seventeenth century explorers of this region, reported numerous villages west of Blackwater NWR along the Patuxent River and east of Blackwater NWR on the Nanticoke and Pocomoke Rivers (Feest 1978:241). No exploration of the Blackwater River is documented for this period, and little is known of the groups that inhabited southern and interior Dorchester County at that time.

Early seventeenth century maps of the region are fairly inaccurate in depicting the lower Eastern Shore, showing a very general coastline, and only the mouths of most drainages (Hawley and Lewger 1635). A 1635 map depicts mountains on the interior of the Delmarva Peninsula, which suggests that little exploration of this area had been

accomplished by that time. Comparing a 1651 map (not shown due to poor quality) with the 1635 map suggests that extensive exploration of the Choptank, Nanticoke, and Pocomoke rivers occurred in the mid-seventeenth century (Farrer 1651). These are also the three major drainages in this area associated with significant Contact period Native American settlements.

No Native American villages are known to have existed near Blackwater NWR during the period 1620–1837 (Feest 1978:241), but reservations for the Choptank and Nanticoke were established near present-day Cambridge in the late seventeenth century (Jones 1966:183–184). Four Indian towns are documented on tributaries of the Choptank River (Davidson 1982:6), north of the project area. In 1669, the 16,000-acre Choptank Indian Reservation was established that consolidated these towns, centered around Cambridge on the Choptank River.

The Choptank Reservation was large enough that it incorporated the towns as well as the traditional hunting territory up to the headwaters of the Little Blackwater and Transquaking rivers (Rountree and Davidson 1997). The reservation was within 3 miles of the northern border of Blackwater NWR, and it is possible that hunting forays extended onto refuge property. Rountree and Davidson (1997:128) estimate that the early seventeenth century population on this reservation was at least 130 people.

Piece by piece, the large Choptank reservation was sold to Euro-American settlers, some with knowledge and consent of the Native Americans, but much without (Rountree and Davidson 1997:147). In 1721, a new survey of the reservation was made and new terms for use established. From that point on, the Native Americans were permitted to use the land not sold up to that point, but they no longer held ownership. In 1792, when William Vans Murray was commissioned by Thomas Jefferson to record the Nanticoke language, he reported that most of the Native Americans had left to join the Iroquois (Mowbray and Rimpo 1987:5). The Choptank reservation was dissolved in 1799.

Local Native Americans have recently incorporated as the Nause–Waiwash Band, and are working on legal recognition and a history (Fitzhugh 1991). One local Native American recollected that their family's seasonal patterns included living in Blackwater and the marshes in the winter, and migrating to Goose Creek and the Chesapeake Bay in the summer and fall (Chase 1992). It is unclear if this is a historical reference regarding contact period use of the refuge or evidence of later seasonal use of the refuge for hunting.

Settlers acquired land on the Eastern Shore rapidly. As early as 1665, only 6 years after the area was officially opened, almost 80,000 acres of land had been surveyed to be issued as grants. In 1666, Somerset County was created, and included what are now Somerset, Wicomico, and Worcester Counties. Dorchester County was established in 1668 and was primarily settled by people from the Western Shore of Maryland, unlike the Somerset County settlers, who primarily came from Virginia. Dorchester County was named for the Earl of Dorset, a family friend of the Calverts.

By the time Maryland was settled, Virginia colonists had shown that soil and climate conditions in the mid-Atlantic coastal plain were highly productive for the growth of tobacco, and that this crop could be very profitable. Tobacco farming required large plots of land, because it quickly depleted the soil of nutrients and crop rotation did not completely restore fertility (Carr 1987:6). Land in the Chesapeake region was relatively cheap and available during the seventeenth and early eighteenth century and most plantations were 200- to 250-acre tracts (Carr 1987:7).

Dorchester County historians Calvin Mowbray and Maurice Rimpo describe the early settlement of the county as beginning along the Choptank River, with at least eight tracts surveyed in 1659, then in the next few years land was acquired on James Island, Taylors Island, Little Choptank River, and Honga River (Mowbray and Rimpo 1987:6). Land was next surveyed along Blackwater and Transquaking rivers, and then the Nanticoke. Lastly, the interior of the county was surveyed. During the years from 1659 to 1668, approximately 170 tracts were patented in Dorchester County, many for residents of Calvert County, approximately 50 percent of whom did not develop the land, but sold it over the next 10 years (Mowbray and Rimpo 1987:6). Richard Preston was an early landowner on Barren Island who apparently used his 700-acre property for pasture (Mowbray and Rimpo 1987:92). He was a Dorchester County delegate to the Maryland assembly who lived on the property he owned near Cambridge.

A study by TRC Garrow Associates, Inc., encountered no direct evidence of any seventeenth-century through early eighteenth-century plantations on Blackwater NWR. A survey of rural cemeteries in the county by the Dorchester

County Historical Society found only three in the county with pre-1700 dates, although a number of unmarked graves were found that could date to this period (Marshall n.d.). One early landowner on Blackwater NWR was Raymond Staplefort, the grandson of Raymond Staplefort, also spelled variously Stapleforte, Staplefoot, and Staplefoote in county records, the first Sheriff of Dorchester County. According to the USFWS site form for BLK–001H, either Raymond Staplefort (II) patented "Blackwater Farm" in 1750, or his father George did in 1726.

Numerous patents to Stapleforts are recorded in this area in the mid to late eighteenth century (Hester 1994:8). Deed records between 1780–1852 were lost in a courthouse fire and the deed string for BLK–001H has not been fully researched. Genealogy of the Staplefort family has been researched by several refuge staff members (Julie Barker and Jeanette Haas), however. Kammeyer (1980) reports that property known as Blackwater Farm was patented by Raymond (II), then passed to George, then to Thomas S., then to Thomas, then to William T., then to John C., and then to Zebulon Mitchell in 1866. This does not explain the presence of the earliest two graves in the Staplefort family cemetery (BLK–002G) though, which are those of Abraham Meekins (d, 1813) and Mary King (d, 1814). Hester also mentions that Dorothy Staplefort left farm land on the west side of Little Blackwater River to her granddaughter Dorothy that she received from William Woolford. Both Dorothys are buried in the cemetery near the house.

The Staplefort estate house was used by Blackwater NWR managers until 1992, when it became unsafe and was demolished (USFWS site form). The family cemetery (BLK–002G) located near the house is still fairly intact, and although the plantation house was reportedly constructed in 1752, interment dates range from 1813–1857 with most falling after 1829 (Marshall n.d.:6; Wilson and Kanaski 1990). The locations of other outbuildings that existed or were constructed during the twentieth century are recorded on the USFWS site form and on 1932 and 1934 maps on file at Region 5 in Hadley, Massachusetts. Twentieth-century construction in the area has impacted subsurface features in some areas, but archaeological features and deposits likely remain intact.

Evidence for one other eighteenth-century occupation (BLK–068H/18DO160) on the refuge exists from a site recorded and collected on a limited scale by Thomas Davidson, at that time the Lower Delmarva regional archaeologist for the MHT. He reported eighteenth century ceramics in the vicinity of a Late Woodland shell midden on Barren Island (BLK–047P). The artifact scatter is located on the east side of Barren Island on Tar Bay and is not associated with any above-ground features (USFWS site form). No structures are depicted in this location on the later 1877 map.

Probably the most famous Dorchester County native from the Civil War period is Harriet Tubman. Born on the Bordess plantation in Bucktown, she was originally called Armitta Ross, and was the daughter of one free and one slave parent. She began escorting slaves along the "underground railroad" in 1850 and returned to Dorchester County at least 11 and possibly as many as 30 times to accompany slaves (primarily friends and family) on their way north to freedom (Pierce 1995). Some of Tubman's methods for evading capture included varying routes, following drainages, avoiding roads, traveling at night, and sleeping in swamps during the day (Pierce 1995). She also preferred to leave on Saturday evening because newspapers were not published on Sundays and runaway notices could not be posted until Monday (Pierce 1995). By that time she and her group could be well into Delaware.

North of Camden, Delaware, the route she used has been well established and several safe houses are known (Bentley 1993). The route from Bucktown to Camden is not known, but it is thought that she followed the Choptank River, and she may have followed the Transquaking River to reach the Choptank River (Bentley 1993). Harriet Tubman's destination on these trips was Philadelphia, Pennsylvania but the original departure locations are not recorded. She specifically used a tactic to allow her a head start, however, and would have tried to get as far as possible before stopping to rest. It is unlikely that, even if the starting point were somewhere within Blackwater NWR, her party would have stopped the night within the boundaries of the refuge.

William Alvin Linthicum constructed a house from 1910–1915 west of the former Captain Linthicum residence on what is currently referred to as Hog Range. The Captain Linthicum tenant house and barns were demolished in the 1950's by W. A. Linthicum's nephew, Herb Asplen, who was farming the land at that time (USFWS site form). The William Alvin Linthicum house (BLK–026S) is still standing. Service archaeologists conducted limited surface reconnaissance in 1993 for several proposed projects in the vicinity of site BLK–026S. The locations of the former tenant house and two barns were identified and shown on a sketch map attached to the BLK–026S site form. The W. A. Linthicum House is a two-and-a-half-story farmhouse sitting on brick piers and oriented toward the road

(Route 335). Bartons Creek that forms the western boundary of this property is now called Buttons Creek. On the 1932 map it is labeled as Hudson Creek.

One school and several residences were located along Key Wallace Drive in 1877, within property now part of the refuge. School No. 4 (BLK–009H) was located on the north side of Key Wallace Drive in 1874, but was apparently used as a single family home in the early twentieth century (USFWS site form).

Several residences, some that were probably tenant farms, were located on the south side of Key Wallace Drive in 1877, including the J. Coulson (BLK–008H), E. W. LeCompte (BLK–007H), C. Reditt (BLK–005H and BLK–063H), and Z. Mitchell (BLK–001H) houses. The Zebulon Mitchell house was previously owned by the Staplefort family and the USFWS site form records this site as Blackwater Farm. This site was described above as the initial occupation began in the eighteenth century. Zebulon Mitchell acquired the Staplefort farm from John C. Staplefort in 1866 (Kammeyer 1980). The Staplefort family cemetery (BLK–002G) is located north of the original residence location and dates primarily to the mid-nineteenth century. The cemetery was the focus of a study conducted in 1990 by Service archaeologists, who confirmed the locations of 19 graves, including two unmarked (Wilson and Kanaski 1990).

The J. Coulson Farmstead (BLK–008H) recorded on the 1932 map (McQueen 1932), included an L-shaped house and two outbuildings to the southwest. Two L-shaped structures with two outbuildings between them are depicted on a 1934 (Cassel 1934) map. This farmstead was impacted sometime shortly after this for the construction of the Civilian Conservation Corps complex. Three structures are shown on the 1942 (USGS 1942b) topographic map and probably include the J. Coulson main house. Refuge staff may have been using this house until 1942 (USFWS site form). This is also the location of the present-day Visitors Center and the entire area has been highly disturbed. The locations of the structures have not been determined by an archaeological investigation.

The LeCompte Farmstead (BLK–007H) is depicted on the 1932 map, (McQueen 1932) which shows the main house, one outbuilding and two wells. The 1934 (Cassel 1934) map shows the main house, six outbuildings, and three wells. The 1934 map is not tied to a known reference point, and the precise locations of structures have not been determined. No structures are depicted in this area on the 1942 (USGS 1942b) topographic map. The easternmost Reditt tenant house (BLK–063H) was removed by 1932. The westernmost Reditt tenant house (BLK–005H) was recorded on the 1932 survey map (McQueen 1932), which shows the house, a well, and an outbuilding.

Both Reditt tenant farms have associated cemeteries. The Wright Cemetery (BLK–006G) is located southwest of the westernmost Reditt house (BLK–005H) and contains the burials of Mary L. Wright and her daughter Mary E. Wright who both died in 1825 (Marshall n.d.:6). Field visits in 1992 and 1993 by Service archaeologists found no surface evidence of markers or an enclosure, but did find a scatter of bricks (USFWS site form). Refuge maintenance workers reported that a burial vault collapsed and was filled in. The Bell Cemetery (BLK–069G) is located south of the easternmost Reditt tenant house (BLK–063H) and contains the grave of Lawamanda Bell, who reportedly died on February 30, 1851. The location of this grave was verified during a field visit by Service archaeologists. The exact location(s) of Wright Cemetery interments have not been confirmed in the field, although the cemetery boundary is marked on a 1938 survey map (Taylor 1938).

East of Little Blackwater River is the Bucktown District. Four residences and a business shown on the Bucktown District map of 1877 are now within the refuge. The homes of D. Clash (BLK–024H), W.J. Elsey (BLK–034H), and George E. Austin (BLK–022H) are shown north of Blackwater River, on the southern edge of Green Brier Swamp, or possibly on an island in the marsh. A structure is depicted on the 1932 map (McQueen 1932) in the approximate location of the George Austin house and is labeled as a cabin on Waterbush Island. According to the BLK–022H site form it was known as Waterbush Island Camp. It is not known whether this site represents the correct location of the 1877 residence.

According to the Bucktown 1877 map, the W. J. Elsey Farmstead was situated northwest, and the D. Clash Farmstead was located north, of the George Austin place. The Service has assigned possible locations for these sites based on compass readings using the 1877 map. Neither has been confirmed by an archaeological or deed investigation. A 1941 appraisal attached to the site form for BLK–023H, a twentieth-century trappers shack on the same property as BLK–024H, describes a two-story frame house in poor condition. This house may also be the

subject of several photographs taken before and during the construction of the Kuehnle Dike, which are included in the May–August 1953 Annual Narrative Report on file at the Visitor Center.

The house is shown at the end of the eastern, or left, fork of a farm road that extends southwest off of Bestpitch Road from Longfield. This location is a more likely candidate for the D. Clash Farmstead. According to the survey noted above, the correct location of BLK–023H (hunting camp) is on a point of marsh on Bear Garden Creek (now called Back Garden) opposite Pear Tree Island. The Dr. Phelps residence (BLK–027H) in Green Brier Swamp also is shown on the 1877 Bucktown District map. Two structures are shown on the 1942 topographic map in this location, but are not shown on the 1982 (USGS 1942b, 1982a) topographic map.

Two structures associated with Carter & Co. (BLK–035H) are shown on the 1877 map at a sharp curve in Maple Dam Road on the east side of Green Brier Swamp. Neither of these structures appears to be depicted on the 1942 topographic map (USGS 1942b), and it is unclear whether these locations are within the present refuge boundary. Hester (1994:15) reports that "there was a country store at Seward, just across the Little Blackwater from the present refuge headquarters, owned by Charles 'Hallie' Seward." The residence of C. H. Seward is shown at the crossroads of Key Wallace and Maple Dam Road, in the area that is now called Seward. No other structures are shown nearby, and it is possible that Carter & Co. was their country store, but this has not been confirmed. The refuge boundaries around Green Brier Swamp include the location of one other 1877 structure, the residence of J. McGrath. The refuge also abuts several structures, including Colored School No. 2 and the residences of Thomas M. Meredith, B. Holt, J. Willey, and William Shorter.

The Hooper's Island District map shows that Barren Island was moderately settled with 13 houses and one school in 1877. All of the residences are located near the shoreline; the only structure on the interior of the island is Schoolhouse No. 5 (BLK–046H). Most of the residences are situated on the east side of the island (BLK–036H/Mary Adams, BLK–038H/J. T. Creighton, BLK–039H/J. Dean, BLK–040H/G. Flowers, BLK–041H/C. Pritchett, BLK–044H/J. T. Creighton, BLK–048H/J. Aaron, BLK–050H/W. Aaron, BLK–051/W. Adams, BLK–052H/Mary Adams, BLK–054H/F. Flowers), and only two are located on the west side (BLK–037H/D. Johnson Farmstead and BLK–045H/J. Dean Farmstead).

None of these sites has been verified by field investigation, but archaeological investigation in the vicinity of BLK–044H, the J. T. Creighton Farmstead southern location led to the recording of site 18DO169. Gardner and Stewart (1977) found a scatter of historic ceramics, including gray stoneware, red earthenware, ironstone, and porcelain along the shoreline. Limited shovel testing failed to produce indications of any structures or artifact concentrations, and the researchers concluded that the J. T. Creighton Farmstead had eroded into Tar Bay. This is true for many of the locations of former structures on Barren Island. According to Service records, a cemetery (BLK–070G) was located west of the schoolhouse, but this is unconfirmed. No structure is depicted in the vicinity of site 18DO160, a prehistoric shell mound (BLK–047P) that also produced some eighteenth century ceramics (BLK–068H). Barren Island was abandoned by the 1920's, except for a gunning club (BLK–042S) on the northwest end of the island, now a ruin (Mowbray 1981:91).

Two residences are depicted on Spring Island on the 1877 Strait district map. These are the G. T. Walters (BLK–061H) and the S. Jones (BLK–062H) residences. This island was owned by Bishops Head Hunting Lodge, Inc. from 1967–1992 (USFWS site form). Neither of these sites has been verified through field investigation.

Three 1877 residences are depicted within the boundaries of the refuge in the Bishops Head area, none of which have been verified in the field. These are the G. Mills (BLK–057H), T. Mills (BLK–058H), and Captain A. Jones (BLK–059H) residences. Several other houses were located nearby and a school (No. 3) was located in what is now the Conservation Fund's demonstration forest. Most of the development at this point in time has occurred north of the refuge near the Bishops Head post office. The Bishops Head post office was in operation from 1860–1947 (Mowbray and Rimpo 1987). All three of the residences within the refuge are situated on the water, but most of the rest of the houses on Bishops Head are oriented along the roads. Settlement on the islands between Bishops Head and Spring Island and east of Barren Island was water-oriented.

In 1927, Delmarva (also spelled "D-e-l-m-a-r-v-i-a" in some references) Fur Farm, Inc., a Delaware firm, purchased a large tract of land in the Blackwater River area to lease sections to farmers and trappers. Land was purchased from Charles and Margaret Seward, Ernest H. Burns, Chester C. Housh, and Wilbert Rawley (Kammeyer 1980).

This 8241-acre tract became the original part of the newly created Blackwater River Migratory Bird Refuge when it was conveyed to the Government in 1933 by means of condemnation. Delmarva Fur Farm, Inc. retained timber, farming, and trapping rights on the refuge for the remainder of the decade (Hester 1994:24). No information regarding this company was found during the research for this project. According to the Delmarva Fur Farm, Inc. president, C. Albert Kuehnle, when the 8241-acre tract was conveyed it included seven farm residences with associated outbuildings (four unoccupied and all but one in poor condition) and four trapper cabins (Kammeyer 1980). Fur trapping continued on the refuge, and in 1975 it was reported that nutria make up one-half of Maryland's annual 500,000-fur catch (Anonymous 1975).

The mounds of oyster shells generated by local packing plants proved to be an excellent surface for roads, but road construction proceeded slowly, and in the early twentieth century, most of Dorchester County was still characterized as rural with scattered, isolated farmsteads. Water travel by small craft was still an efficient means of local transportation within the refuge area. Settlement density declined along Blackwater River after the establishment of the refuge.

One other twentieth century site is recorded on the refuge, BLK–003S, or Quarters 2. It is described on the site form as a typical house and garage of the second quarter of the twentieth century. This site is located north of the cemetery (BLK–002G) associated with the Staplefort House (BLK–001S). The date of construction is not known, but it is not shown on the 1932 survey map (McQueen 1932) or the 1933 sketch map of Site BLK–002G and BLK–001H.

The "Blackwater Migratory Wildlife Refuge" was created in 1933, and the initial improvements were performed by Civil Conservation Corps (CCC) workers under the supervision of Army officers (Hester 1994:26). The CCC established a headquarters (near the present-day Visitors Center) and built roads, dug ditches, and excavated a dike. The headquarters was constructed on the former J. Coulson Farmstead (BLK–008H), impacting that site, also impacted later by the construction of the Visitors Center.

Agricultural lands on Blackwater NWR were leased to local farmers until 1989, when the refuge staff took over farming activities in an effort to attract waterfowl. Improved water control systems have been constructed, including miles of dikes and freshwater impoundments. Other improvements were directed at the human visitors to the refuge, and include a Visitor Center and Education Building, Headquarters Office, foot trails, Wildlife Drive, and parking areas.

Cultural Resources

Several Federal laws required Federal agencies to locate and protect historic resources (archaeological sites and historic structures eligible for or listed in the National Register of Historic Places) on their land or on land affected by their activities. In Region 5, the Regional Historic Preservation Officer oversees compliance with these laws and consults with the Maryland Historical Trust when necessary. This legislation keys site preservation to National Register of Historic Places eligibility, a measure of the site or structure's quality. Federal agencies are also charged with locating, evaluating and nominating sites on their land to the National Register.

Blackwater NWR and the Barren Island, Bishops Head and Spring Island Divisions of the Chesapeake Island Refuges.—Information about archaeological sites and historic structures at Blackwater NWR comes from two sources.

Our Region 5 Archaeological Site Inventory and cultural resource project files provide the location of prehistoric and historic archaeological sites discovered during limited archaeological surveys of proposed project locations on the refuge. In addition, the site inventory contains locations of nineteenth century structures based on an 1877 map of the area. Most of these locations have not been confirmed in the field. Because the refuge predates historic preservation laws, the Region 5 Real Property Inventory also provides information about, and photographs of, refuge structures that have been removed and demolished.

The second source of information about Blackwater's cultural resources is a set of sensitivity maps showing the probability of cultural resources being located on various Blackwater land forms. These maps were developed to assist in long term planning for the refuge, and incorporate information about landscape changes through time. In 1997, TRC Garrow Associates, Inc. conducted a cultural resource reconnaissance study of the Blackwater NWR to

provide information about archaeological sites and landscape formation on the refuge. The reconnaissance survey consisted of a literature review and limited field survey for archaeological sites and palaeoenvironmental information. Their report, "Archaeological and Geomorphological Reconnaissance at the Blackwater National Wildlife Refuge, Dorchester County, Maryland" was submitted in final in May 2000. This document includes the sensitivity maps mentioned above and specific site locations of historical and archaeological sites on Blackwater NWR, Barren Island, Bishops Head, and Spring Island.

Blackwater NWR

Blackwater NWR contains nine known prehistoric archaeological sites, and 60 historical archaeological sites. Because no comprehensive subsurface archaeological survey has been conducted, these known sites are likely to represent only a small subset of all preserved sites on the refuge. Seven of these prehistoric archaeological sites have been reported by collectors or identified during inspections of the ground surface by archaeologists. Two additional prehistoric sites were located during subsurface testing as part of the Garrow study.

There is little information about the quality or character of the seven original prehistoric sites, and not enough information to evaluate the National Register eligibility of the sites. Six of these seven original sites are on Barren Island. Changes in the shore line of Barren Island mean that at least four of these Barren Island sites are likely to have been inundated or damaged since they were reported in 1985. The condition of these six sites has not been checked since they were reported 15 years ago. The seventh original prehistoric site is in an 85-acre field which extends deep into Green Briar Swamp. This site is known only through finding an undated projectile point on the surface. Surface inspection of the site as part of the TRC Garrow study yielded no new artifacts, and showed no signs of disturbance.

One of the two newly discovered prehistoric sites, 18DO399, which has Late Woodland Period (A.D. 900–1600), nineteenth, and twentieth century components, is likely to be eligible for the National Register, based on work done there by TRC Garrow Associates as part of their reconnaissance study. This means the site is likely to contain important information about prehistory. The site is at least 60 X 165 meters in extent, and a radio carbon date on charcoal from a basin shaped feature has been calibrated to a range of A.D. 1275–1425. The site is contained in deposits likely to have formed through river and estuary deposition activity.

Almost half of the known prehistoric archaeological sites in the vicinity of the refuge date to the Woodland Period, characterized by more sedentary village life and maize agriculture (Millis et al.,1998:78). Until about A.D. 1250, the climate was unusually warm and sea level was similar to today. Between A.D. 1250 and 1900, global climate was cyclically colder than today. This affected the Atlantic Slope and thus, Blackwater NWR. Sea level during the period of this Late Woodland site's occupation was lower than today by 2 or 3 feet. Thus, the time when the site was occupied was a period when the refuge was more suitable for human habitation than today. At the time of occupation, the site was along side fresh water, and remains contain no evidence of shellfish harvesting.

The second newly discovered prehistoric site at Blackwater, 18DO400, seems to contain few artifacts. A flake of quartzite produced during tool making and a worn sherd of Middle to Late Woodland Period pottery are the only artifacts. These artifacts had been disturbed by plowing, but limited testing at the site was not enough to evaluate the site's eligibility for the National Register.

Most of the 60 historical archaeological sites in the Archaeological Site Inventory are believed to exist based on an 1877 map. Most locations have never been confirmed in the field. In addition to these inventoried potential nineteenth century sites, there may be unlocated seventeenth and eighteenth century historical archaeological sites at Blackwater, as well.

The Eastern Shore was open to patenting in 1659, but period maps indicate that most settlement was along the Bay shore and the lower reaches of major drainages until the eighteenth century (Millis et al., 1998:83–84). Maryland's Eastern Shore was settled by Anglo-Americans from the Western Shore, driven by the need for fertile well drained tobacco farming land. The land along the Blackwater and Transquaking Rivers was surveyed for sale a few years after1659. Barren Island was used for pasture by an owner living in Cambridge. By 1673, plantations along Parson's Creek and Slaughter Creek may have extended into the refuge (Millis et al., 1998:84). Because early transportation was by water, sites related to these plantations would have been oriented to the rivers and creeks, rather than

nineteenth and twentieth century roads. No historical archaeological sites or structures sites on the refuge are known to date to this period.

Blackwater contains two confirmed eighteenth century archaeological sites. By the eighteenth century, perhaps as early as 1726, the Stapleforts were farming on the refuge, on the bank of the Little Blackwater River. Twenty seven other eighteenth century patents included refuge land. The Staplefort "Blackwater Farm" site is BLK–001H. The site is likely to contain intact archaeological deposits, even though there has been twentieth century disturbance. By the early eighteenth century, Maryland farmers used slaves for labor, and as yet unlocated slave quarters and cemetery may be part of BLK–001H. A 1794 map shows Routes 16, 335, and Key Wallace Drive traversing what is now the refuge. Subsequent change in sea level means that some formerly habitable locations along these roads and elsewhere in the refuge may now be poorly drained or submerged. In addition to the Staplefort site, Blackwater contains an eighteenth century site in the vicinity of a Late Woodland Period prehistoric shell midden (18DO160 or BLK 047P/068H) on Barren Island.

Martin NWR

Before about 8000 years ago, Smith Island was an upland area west of the paleochannel of the Susquehanae River. Archaeological sites from the Paleoindian Period and Early Archaic Period on what is now Smith Island are known only from collections made by non-professionals. No professional archaeological surveys of the island have been completed.

Archaeological site inventory records at the Maryland State Historic Preservation Office contain information about 15 archaeological sites on the refuge. Four of those sites are prehistoric, located along the shore of the island, and contain Archaic and Woodland Period remains. One of the four prehistoric sites also contains the remains of nineteenth-century Historic Period occupation.

Eleven Historic Period archaeological sites are known, nearly all on the west shore of the island. Three of these Historic Period sites are known to date to the 18th century. The remaining sites are so far only known to date to the 19th century. The shoreline locations reflect not only a preference for access to the Bay's resources, but also the visibility of eroding sites on the shore. Work by the Service and a Maryland State Historic Preservation Office intern has not been detailed or systematic enough to evaluate the eligibility of the site for the National Register. The current condition of the other 14 sites is not known.

The changes in the environment of the refuge through time means that prehistoric people used the refuge for different purposes at different periods. Prehistoric hunters may have hunted on the refuge, and campsites at former ridge saddles and stream mouths may still exist in today's marshes and islands in the marshes. These sites will be difficult to locate with standard archaeological survey practices, but may continue to be exposed and destroyed by shoreline erosion.

During the Revolutionary War, many Smith and Tangier Islanders were loyalists. The island was known as a haven for Tories, deserters and escaped prisoners. Tory picaroons and British ships foraged for provisions on Smith Island, and American ships punished islanders for disloyalty. About 1780, the Maryland Council constructed a fleet of shallow draft, 25 man barges capable of carrying oars, sails, and guns. In November, 1782, the British defeated some of these Americans in the Battle of the Barges in Kedges Strait, on the north end of Smith Island.

Solomon Evans watched the battle from a tree on what is now the refuge, at that time his family's farm. As subsidence, sea level rise, and human excavation of channels created more open water, reduced the amount of well drained land, and reduced the size of the island, late eighteenth century house and farm sites in the interior tended to remain occupied. Comparison with maps of the late nineteenth century shows that interior farm sites from that period are recognizable on modern aerial photos as hummocks with trees such as hackberries. It is likely that the interior hummocks on the refuge contain as yet undocumented historic archaeological sites. Many shoreline historic sites have been lost to or damaged by erosion, however. In addition, marsh has overtaken much of the well drained land of the eighteenth and nineteenth century. It is likely that some farm sites and fishing and processing locations are now under water or marsh.

From the early 19th century on, two lighthouses were operated at Fog Point and Solomon's Lump. Both locations are now off shore. One early lighthouse keeper, Lorenzo Dow Evans, participated in documenting bird kills during migration periods, assisting in early migratory bird research. His records are exhibited at Patuxent Research Refuge in the National Wildlife Visitor Center. There are no known remains of the lighthouses, and their sites are not likely to be within the Service's current ownership.

By 1820, New England had so depleted its oyster beds that the Chesapeake Bay became a profitable source to harvest and market oysters in the North (Horton 1996:43). This activity peaked in Maryland in 1886 (Horton 1996:44). The refuge shore may contain evidence of early oyster processing operations from this period.

The refuge owns one structure in the village of Ewell on Smith Island. The 1916 Charles D. Middleton house has been altered, including replacement of its windows. The Regional Historic Preservation Officer feels the house is unlikely to be eligible for the National Register. It is currently used as an education and interpretation center for the refuge.

Susquehanna NWR

Susquehanna NWR has no known archaeological sites. The U.S. Coast Guard owns the National-Register-listed Fishing Battery Lighthouse, located on a portion of Battery Island that the Department of Commerce retained when the refuge originally was established.

Socioeconomic Environment

Regional Overview

On the Delmarva Peninsula, we will focus on those counties that compose the watersheds of Marshyhope Creek, the Blackwater, Little Blackwater, and Nanticoke rivers, and the island communities of Smith Island; Caroline, Dorchester, Wicomico, and Somerset Counties in Maryland; and Sussex County in Delaware. We will discuss Dorchester and Somerset Counties in greater detail, because they contain the existing Blackwater and Martin NWRs. Harford County in Maryland, Kent County in Delaware, and Watts Island in Virginia contain only very small percentages of the study area, and so are not discussed.

European colonists and their descendants have populated, farmed, logged, and otherwise altered the Eastern Shore for more than 300 years. Before that, Native Americans lived on the Delmarva Peninsula and affected the landscape for thousands of years. With humans providing such a long, varied, and continued impact on the study area, it is important that we understand the past, present, and future human context.

Land development on the lower Eastern Shore is driven by geography, transportation routes, and proximity to metropolitan areas. Major transportation corridors are the key to development growth in the area; counties showing most growth are in the Upper Shore area, including Caroline County in Maryland. Over the past three decades, the Upper Shore area grew at greater rates than the other Eastern Shore counties. They serve as bedroom areas within a 1-hour commute of the employment centers of Baltimore, Washington, or Wilmington. Consequently, the demand for rural and residential land in these areas is increasing.

Access to and through the peninsula is afforded by the transportation corridors of U.S. Routes 50 and 13, Interstate 95, and Maryland Route 404. These routes link the Baltimore–Washington metropolitan areas on the Western Shore to the Maryland–Delaware seacoast. Because of commuting distance and time, Dorchester County is at the extreme southern limit of daily western shore commuters. For the amenities afforded by waterfront living and recreation, as well as the lower density of population, people have sought locations in the mid-shore and lower shore areas for retirement homes and secondary or recreational homes.

County Descriptions

Caroline County

Caroline County, Maryland, lies in the upper northwestern portion of the Nanticoke River and Marshyhope Creek watershed. The county is bounded on the north by Queen Anne County; on the west by the Tuckahoe River and Talbot County; on the east by the State of Delaware; and on the south by the Choptank River and Dorchester County.

Caroline County is primarily a rural agricultural community that focuses on grain and vegetable crop production. However, since Bay Bridge opened, the county also has served as a bedroom community to Baltimore, Washington, D.C. and Wilmington. The linking of Maryland Route 404 to U.S. Route 50 at Wye Mills enabled a boom in county population, connecting it to those major metropolitan areas as well as to the seacoast areas of the peninsula. The population of the county within the Nanticoke watershed is expected to grow at a rate of about 12 percent over the 30-year period from 1990 to 2020.

Its total land area (excluding water acreage) is 205,383 acres, with approximately 20 percent, or 40,337 acres, within the Blackwater and Nanticoke rivers watershed. The predominant land use is agriculture (57 percent), then forest (38 percent), and urban or residential (4.5 percent). Some industry is located in Denton and Federalsburg, and manufacturing accounts for about 21 percent of total employment.

On a percentage and acreage basis, change in land use is greatest in Caroline County, of all Maryland counties within the watershed. Development pressure, particularly along Marshyhope Creek, is expanding rapidly; approximately 6.7 percent of the agricultural and forest land has been converted to residential or urban use since 1973.

Table 3.17. Counties employment by industry percent[1]

Industry	*Caroline*	*Wicomico*	*Dorchester*	*Somerset*	*Sussex*
Agriculture, Forestry and Fisheries	6	4	9	18	6
Mining (sand and gravel)	0	0	0		0
Manufacturing (durable goods)	8	7	14	5.1	5
Manufacturing (non-durable goods)	19	8	17	5.1	18
Construction	8	8	9	5.1	10
Retail trade	16	18	11	13	16
Wholesale trade	5	5	4	7.2	4
Finance, Insurance, Real Estate	4	5	2	4.1	4
Health Services	6	9	8		8
Educational Services	5	9	5		6
Other Services	11	14	9		13
Other	12	13	12	3.1	9

[1]Percent of employed persons 16 years and older

Dorchester County

Dorchester County, Maryland, is the watershed for the Blackwater and Little Blackwater Rivers, much of Marshyhope Creek, and the lower reaches of the Nanticoke River. Located in the southwestern portion of Maryland's Eastern Shore, it is bounded on the north by the Choptank River and Talbot and Caroline Counties; on the west by the Chesapeake Bay; on the south by Bloodsworth Straits and Tangier Sound; and on the east, by the Nanticoke River, Wicomico County, Maryland and Sussex County, Delaware. The county is virtually surrounded by water, except for the point of “attachment” in its northeast section.

U.S. Route 50 connects Cambridge, the county seat, to the Baltimore–Washington area and to the Maryland seacoast. The extension of Maryland Route 16 west of Cambridge and the Cambridge–Vienna section of Route 50 separate “North Dorchester” from “South Dorchester”. The division of the county is due to geographic differences that also affect the extent and nature of development and the use of the land. Prime agricultural soils, those most easily converted to residential or industrial development, are found in North Dorchester. Not surprisingly, most new residential development is also in North Dorchester County, in the Cambridge–Hurlock corridor.

The county’s population has been growing very slowly, with a 3-percent increase from 1970–1990. Population decreased slightly from 1980 to 1990. The only portions of the county with significant population gains between 1970

and 1990 were in North Dorchester. With the exception of Hurlock and Secretary, all of the incorporated towns lost population between 1970 and 1990. Most portions of South Dorchester had a more than 10-percent loss of population between 1980 and 1990. Many districts had a more than 30-percent population loss between 1970 and 1990. The 1990 census characterized 92.9 percent of the population as rural in nature, and of that, 5.4 percent were on farms, and 7.1 percent were considered urban. Although the Blackwater and Nanticoke rivers watershed spans 67 percent of the county, it contains only 30 percent of the population.

Compared to other Maryland counties, Dorchester County is relatively poor. Dorchester has a higher proportion of low and moderate income households and a lower effective buying income. In 1990, 14 percent of the population was below the poverty level. The county's housing stock is older, and housing values are lower compared to other counties. A higher proportion of homes are substandard.

Table 3. 18. Dorchester County land use[1]

Land Use	*Acres*	*Percent*
Residential	9764	2
Non-residential[2]	2389	1
Agricultural	107,426	30
Forest	143,878	41
Extractive/ Barren	342	>1
Wetland	86,507	25
Total	**350,306**	**100**

[1]1990
[2]Commercial/industrial

The county's economic problems include an estimated 1,150 manufacturing and warehouse jobs that have been lost since 1986. Non-manufacturing employment has increased in recent years, but has not made up for that loss. The county's unemployment rate was 9.8 percent in 1993, up from 7.6 percent in 1990. The Statewide unemployment rate was 6.2 percent in 1993. Dorchester County's share of regional employment fell from 20 percent in 1971 to 15 percent in 1992. Competing job opportunities, decreasing yields, and increasing operating expenses resulted in the decline of farming, forestry, and fishing occupations. Social problems have been cited as contributing to labor force quality problems and lagging incomes.

Dorchester's two industrial parks are located in the incorporated towns of Cambridge and Hurlock. Approximately 1900 acres are zoned industrial in the unincorporated parts of the county.

Agriculture is a key industry for Dorchester County, which ranked 7th in value of products produced in Maryland. According to the 1992 Census of Agriculture, Dorchester's 347 farms (123,762 acres) covered one-third of the county's land, down from the 438 farms (139,416 acres) in 1982. The total value of all agricultural products sold exceeded $64 million, the most valuable products being poultry and poultry products, followed by soybeans, corn, and wheat. Fresh vegetables, aquaculture, and watermelons, and hogs are also important. Approximately 500 farm employees earned more than $3.3 million. In 1992, 3,170 acres were enrolled in agricultural preservation districts, and 1,303 acres were protected from development by perpetual easements. With the advent of the Rural Legacy Program and other incentives, thousands of additional acres have been protected from development in recent years.

Table 3.19. Dorchester County land and water area

Area	*Acres*	*Percent*
Water (excluding wetlands)	278,800	44
Land	350,300	56
Total	**629,100**	**100**
Chesapeake Bay Critical Area	176,600	50*
Wetland (tidal and non-tidal)	86,500	25*

* percent of land area

Historically, woodland and forest products have been important to Dorchester County's economy. Ninety-eight percent of the forest land is privately owned: 40 percent by farmers; the remainder, by industry and private individuals. Loblolly pine is the principal commercial timber species because it grows rapidly and straight. A local forestry board, appointed by the secretary of the State's Department of Natural Resources, reviews timber harvest plans within the Chesapeake Bay Critical Areas. Outside the Critical Area, forest resources are protected primarily through non-tidal wetlands regulations and the county's forest conservation ordinance. Loss of forest land to crop farming has declined, and the size of the county's forest resources has stabilized.

Sand and gravel are the county's only mineral resources. Areas of potential sand or sand and gravel are located mostly in North Dorchester, and south of Vienna to Henry's Crossroads. The sand and gravel industry grew from one operator in 1966 to seven in 1992. Most operations are north of Route 50. As of 1994, 220 acres were under permit form mining and 111 acres were actively being worked.

Tourism has significant potential in contributing to Dorchester's economy. Compared to other counties in Maryland, Dorchester ranked 21st out of 24 in terms of expenditures by travelers. The Offices of Tourism and Economic Development estimate that Blackwater NWR generates approximately $15,000,000 annually, or almost 90 percent of the county's tourism revenue. The new Sailwinds Park and Hyatt Conference Center will undoubtedly have a significant effect on the county's tourism industry in years to come.

Approximately 60 percent of Dorchester County lies in the 100-year flood plain. Most of that is tidal flood plain. As of 1990, 15 percent of the county's population lived in the flood plain.

Table 3. 20. Dorchester County forest statistics

Total forest area[1]	162,000 acres
Commercial forest area (% of county)	141,000 acres (40%)
Predominant tree species (% of forest)	loblolly pine (3%) oak–pine (28%) hardwood (41%)
Value of standing saw timber	$43.9 million
Number of forest landowners	2,200
Number of tree farms[2]	64
Number of forest industry jobs	150

[1]1995
[2]1980

At 350,300 acres of land, Dorchester County is Maryland's largest county. Dorchester has large natural resource areas, including substantial coastal areas, wetlands, forests, and agricultural lands. The county is characterized by open, natural, agricultural, and forested areas. Only 3 percent of its land is developed. As shown in the tables above, its developable land area is small, compared to the entire county.

Wicomico County

Wicomico County, Maryland, is bounded on the west by the Nanticoke River and Dorchester County; on the north by the State of Delaware's Sussex County; on the east by the Pocomoke River and Worcester County; and on the south by Somerset County and Tangier Sound. Salisbury, the county seat, is located in the center of the county, at the intersection of U.S. Routes 50 and 13. Due to its location at this major intersection, the city has grown in commerce and industry, and social and cultural development. It is the area's transportation and industrial center. The population of the county is nearly 80,000 persons, while more than 40,000 persons live in the Salisbury metropolitan area.

People in Wicomico County make more money and are less likely to be below the poverty level compared to other counties in the study area. This comparative wealth likely is due to the growth and prosperity of Salisbury.

Somerset County

Somerset County, Maryland, is the southernmost county on Maryland's Eastern Shore. It lies along the Chesapeake Bay side of the peninsula and its county seat, Princess Anne, is 14 miles south of Salisbury, approximately 120 miles southeast of Baltimore, and 100 miles north of Norfolk, Virginia, via the Chesapeake Bay Bridge Tunnel. The county has a land area of some 330 square miles, including several islands in the Chesapeake Bay. The county's northern and southern boundaries are the Wicomico River and Pocomoke River, respectively.

The county is strategically located to take advantage of a number of opportunities for both development and conservation. Crisfield is important as a fishing, shipping, and tourism center, while Princess Anne's significance as the historic country seat lies in its potential to attract businesses and tourism. To the northeast and southwest of Princess Anne, respectively, are the campus of the University of Maryland (Eastern Shore) and the new State Penitentiary. The county's proximity to Salisbury, Pocomoke, and Ocean City is both an advantage in terms of the availability of services, as well as a disadvantage in terms of the net migration of jobs out of the county. The county depends on Routes 13 and 413 as its lifelines. Route 13, in particular, channels thousands of regional vehicle trips a day through the county en route from New York and Philadelphia to Norfolk and the south.

Somerset County has a shoreline of more than 600 miles along the Chesapeake Bay, and its character varies from fishing communities and summer homes, to marshland and wilderness. Several peninsulas, or necks, extend into the bay separated by meandering rivers. From north to south the necks are: Victor Neck, Monie Neck, Revells Neck, Manokin Neck, and Crisfeild Peninsula. The principal rivers are the Wicomico, the Manokin, which has its source in

the vicinity of Princess Anne, and the Pocomoke. The interior of the county is generally flat, with good agricultural soils punctuated by areas of poorly drained wetlands. Somerset County also includes South Marsh Island, Smith Island, and Janes Island in the Chesapeake Bay. Only Smith Island is inhabited, with settlements at Ewell, Rhodes Point, and Tylerton.

Somerset County experienced major changes in the 1980's. The traditional water-oriented economy has declined in part due to changes in the ecology of the Chesapeake Bay itself. Development pressures have continued in bayfront communities. Development pressures have also increased in the Routes 13 and 413 highway corridors, bringing major increases in traffic. Throughout the 1970's and early 1980's, however, Somerset County's population declined. During the late 1980's, the population began to increase, and a steady growth rate has continued since.

Table 3. 21. Counties land use by percent[1]

Land Use (Percent)	*Caroline*	*Dorchester**	*Wicomico*	*Somerset**	*Sussex*	*Total*
Agricultural	57	30	41	30	53	52
Forested	38	41	55	38.1	44	45
Urban	4	3	3	3.8	3	3
Total	**99**	**74**	**99**	**71.9**	**100**	**100**

[1]Based on actual watershed acreage, *excluding* water and wetlands
*Dorchester and Somerset Counties are 25% and 29.1% wetlands, respectively.

In 1989, roughly 33 percent of the population was concentrated in the Crisfield area, 22 percent in the Princess Anne area, and the remaining 45 percent distributed throughout the county. Within the incorporated limits of the county's main centers, Princess Anne had 1,590 residents, and Crisfield had 2,830. According the 1980 Census, African Americans constituted 34.5 percent of the population, down slightly from 37.5 percent a decade earlier. Other minorities totaled less than 1 percent.

The median age of county residents in 1980 was a relatively high 32.1 years. Birth rates were lower, and death rates were higher than the State averages, the county's per capita income is roughly two-thirds of the State average. Household size has steadily declined. Many of these statistics reflect the declining rural economy. Future trends may be toward an expanding urban economy based on service industries, tourism, and aquaculture, rather than fishing, agriculture, and food processing.

Tourism represents a major opportunity to create new jobs. The county is rich in waterfront amenities and rural viewscapes, including pristine salt marsh and wildlife management areas. In addition, it boasts historic and cultural traditions dating from the 17th century. More than 400 historic and cultural sites are located in the county, and 60 of these are on the National Register of Historic Places.

Smith Island.—Perhaps the most unique and charming place in Somerset County is Smith Island. The culture and society of Smith Island, the location of Martin NWR, is deeply rooted in its ancestry. The independent and pioneering spirit that brought the first settlers almost 350 years ago still prevails. Today's Smith Islanders are not completely isolated from modern society, but their way of life is so unique, and their traditions are so strong that they remain a world apart. Smith Island has no formal government. There are no police, and no need for them. There were no street names until recently. The church is the center of life on the island, and much of the social life on the island is organized around the church. The church, through annual tithes from the members and even non-members, handles such civic responsibilities as maintaining public areas. Water supply is handled by several independent companies formed by a few families joining together to dig a well.

Nearly all the permanent residents of Smith Island depend on the seafood industry for their livelihood. Seafood is harvested and either processed locally or packed for shipment. Although crabs dominate, oysters and clams are also harvested and shipped across Tangier Sound to Crisfield. The return trips yield supplies and petroleum. There are an estimated 150 commercially used boats on Smith Island. Fifty come from Tylerton, 30 from Rhodes Point, and 70 from Ewell. Sixty percent of the boats are "tongers" or oyster vessels, and 40 percent are "scarpers" or crab boats. In practice, 80 percent of the boats are used for both oystering and crabbing. While there is no other industry on the island, a museum, restaurant, and gift shop cater to the seasonal tourists disembarking from the tour boats from May to October.

Each town has a distinct character. There is pride within and rivalry among the three towns. Ewell, the most populated with more than 200 residents, and is considered the unofficial capital city and the most metropolitan.

Ewel1 is home to the new visitor center, restaurants, a gift shop, and bed and breakfast lodging facilities. Ewel1 is connected to Rhodes Point by road. Along the road between the two towns, there is an incinerator and a waste treatment facility that is shared by both towns. Rhodes Point is built along a single road. It is the second most populated town with approximately 100 people. Rhodes Point is the most endangered of the three towns due to its proximity to the open Bay.

Rhodes Pointers are required to travel to Ewell for many of their amenities; however, the Marine Railway, a boat-building and repair facility is located at the southern end of Rhodes Point. Tylerton is the most isolated, being separated from the other communities and accessible only by boat. It is said that Tylerton may be the most devoutly religious of the towns. Cars are a rarity there, but bicycles, golf carts and cats are not. Mail is delivered by boat to the post offices at Ewell and Tylerton; mail for Rhodes Point is routed through the Ewell post office.

Each of the towns is indeed unique unto each other, and undeniably unique compared to the rest of modern society. The life of an islander is filled with hard work. The men are up at 3 a.m. to get an early start on the water. The women pick crab meat, maintain the households, and help cultivate the soft shell crabs in the shanties. Most of the residents are descendants of the original settlers. In recent years, the population has been shrinking at an accelerated pace.

A major contributor to this trend is the feeling that the island and its towns will be uninhabitable 20 to 50 years from now due to erosion. The younger residents are moving away, and the population is declining thru the attrition of its elders. This irreplaceable culture is threatened with extinction. Like no place else in Maryland, the Smith Islanders live with nature. Life is dictated by the tides and winds, and the abundance of life in the water. Big Thorofare Channel separates Martin NWR from the settled areas of Smith Island, and is the most important water access to Ewell.

Access to Smith Island may be had by three ferry boats which ply between the island and the port of Crisfield. These boats usually leave the Port of Crisfield around noon 6 days a week. The Island Star is a convenient tourist boat and may be had by appointment.

Ewell.—The initial patent for Smith Island dates to 1679, when 1,000 acres surveyed as “Pitchcroft” for Captain Henry Smith, the island's eponym and a prominent figure in early Somerset County history. Henry Smith first appears in county records in 1669 as having relocated from Accomack County, where he was drawn into divorce proceedings by the Virginia court. Despite his marital problem in Accomack, Smith assumed prominent roles in Somerset as justice of the peace, a captain of the militia, and a representative from the county in the Lower House of Maryland General Assembly. Although he owned the large “Pitchcroft” tract, it is thought Smith actually occupied a tract patented as “Smith's Recovery”, located on the south side of Manokin River near the confluence of King's Creek.

Tax records indicate the island was occupied during the eighteenth century, and Dennis Griffith's map of Maryland, first drawn in 1794, indicates what was probably an earthen fort at the north end of the island. The presence of the fort as well as the island's strategic location at the bottom of the bay encouraged British occupation during the Revolution and later during the War of 1812.

The buildings that compose the small village of Ewell include many two-story, two- and three-bay frame dwellings, some of which date from before the Civil War. One of the oldest houses to stand until recent times was the house called Pitchcroft, located at the north end of the island.

Tylerton.—Tylerton is a small watermen's village located on Smith Island in Tangier Sound. Tylerton is geographically separate from Ewell and Rhodes Point by Tyler Creek, which runs between the island's two principal land masses, Merlin Gut runs east of the high ground on which Tylerton was built. During the nineteenth century, a ferry operated between the two land masses, but now access is provided only by private boat travel.

Tylerton retains a more diverse collection of period dwellings than the other Smith Island villages. Two of the houses appear to date from the antebellum period. A group of “telescope” houses with three distinct parts contrasts with the more standard two-story, two- or three-bay houses. A large percentage of the dwellings retain decorative exterior trim such as eaves brackets or intricately sawn barge boards. The largest building in Tylerton is the Gothic

Revival Methodist Church in the center of the village. Quiet foot paths and large shade trees contribute to the continuing nineteenth century character of the community.

Rhodes Point.—Rhodes Point is the smallest of the three communities located on Smith Island. Rhodes Point, formerly "Rogues Point," developed along Shanks Creek at the southwest tip of the island and by 1877 included a score of frame houses and a school. The waterman's village consists of approximately two dozen one- or two-story houses and the Calvary United Methodist Episcopal Church. Built in 1921 the L-shaped frame church has Gothic Revival style doors and windows. The houses largely consist of two basic types: the three-part telescope dwelling and the two-and-a-half-story, cross-gabled frame house with a rear service wing. The largest structure standing in the village is a turn-of-the-century frame house on the north side of the bridge. Distinguished by a pyramidal roof with multiple gables, this squarish building is surrounded by a Tuscan-columned front porch. Located on the west side of the village road is a group of single story watermen's work shanties of board-and-batten construction.

Sussex County

Sussex County, Delaware is predominantly a rural, agricultural county that is experiencing rapid growth along the Atlantic coast and moderate growth in the Seaford area, within the Nanticoke watershed. The western portion of Sussex County includes agricultural areas near the Maryland line. About half the county's population lives within the Nanticoke watershed. The industry and commerce of Seaford, and its water-based opportunities are made possible by the navigable Nanticoke River.

Community Attitudes and Opinions

Just as important as the factual data above are the opinions and attitudes of local residents. In March 1995, the Maryland Chapter of The Nature Conservancy hired the Cromer Group to conduct a random sample phone survey of 400 adult residents from throughout the Blackwater and Nanticoke rivers watershed. TNC's Delaware Field Office also was contracted by DNREC Division of Water Resources in 1994 to do a more limited opinion survey of 45 landowners who owned property along the Nanticoke River or its tributaries in Delaware. Some of the more salient findings as presented in TNC's Nanticoke River Bioreserve Strategic Plan follow.

Maryland Survey

First, people living in the watershed tended to be long-term residents. About 85 percent of all survey respondents had lived in the area for 10 years or longer. Nearly 70 percent of all residents agreed that "the quality of life in this area is truly one of the best I think I could ever find."[7]

People in the watershed also had generally favorable opinions of the groups that are active in their area. Of the groups rated during the survey, the Chesapeake Bay Foundation (CBF) had the highest rating, at 7.2 out of a possible 10, while TNC registered 6.5 on the same question. The Fairness to Landowners Committee ranked last, at 5.2. Similar statistics held true for name recognition: 89 percent had heard of CBF, 72 percent had heard of TNC, while only 60 percent had heard of the Fairness to Landowners Committee, the lowest rating of any group mentioned.

The Fairness to Landowners Committee works primarily to support private property rights. It seems, however, that their central issue has little support in the watershed. When asked to support either a pro-private property rights statement, or an anti-property rights statement, only 12 percent favored the former, while 66 percent favored the latter. Additionally, testing on various statements found that only approximately 6 percent of the respondents were anti-environmentalists.

Respondents seemed to single out development as one of the least desirable activities for the watershed. Although 77 percent rated real estate development as very or somewhat important to the local economy, 67 percent of all

[7]Anonymous responder

residents agreed that, as a whole, development on the Eastern Shore is beginning to destroy our way of life. Also, 83 percent of the farmers surveyed opposed the idea of selling parts of their land for development.

Delaware Survey

Most landowners surveyed stated very clearly that they wanted their land to remain untouched. Forty-four percent of respondents said their long-term intention was to pass their property on to their children, while an additional 22 percent said they intended to maintain the land in its present condition. Only 15 percent planned eventually to sell their property or develop it.

Most landowners surveyed (58 percent) conveyed their disinterest in speaking with any entity regarding conservation of their lands. Of those who did indicate a willingness to discuss land protection, a majority chose The Nature Conservancy as the entity with whom they would be most interested in working.

In assessing landowners' knowledge of wetland functions and values, it was found that, in general, people were most knowledgeable about the role of wetlands in flood control (avg. score 4.07, with 5.00 being the highest possible score). People were also very knowledgeable about the importance of wetlands for wildlife habitat (4.02) and fisheries habitat (3.93). In descending order, survey respondents understood the value of wetlands for surface water quality (3.82), ground water quality (3.77), ground water quantity (3.61), and rare plant habitat (3.57).

While only about 1 in 4 survey respondents had heard about the wealth of state-listed rare species in the area, residents seemed a bit conflicted about whether to welcome them. Eighty-three percent of those surveyed said that endangered species are a bad thing (but the result can be construed either as bad for people, or as bad for nature). However, while 44 percent favored jobs over environmental protection, 88 percent believed there is a moral responsibility to protect all of God's creatures. These somewhat conflicting results suggest that certain messages and wording resonate more than others.

Groundwater is a larger and clearer concern than endangered species. Two-thirds of the residents rely on groundwater, and 63 percent feel that high cancer rates in the region may be due to the (poor) quality of the groundwater. A vast majority believes that the river is in worse condition than it used to be. Therefore, while we may have limited support for citizen action to protect rare species, we will have more support for actions to clean up groundwater.

Recreation and Tourism

Given the counties' composition of agriculture, forests, wetlands and waters, there is a long history of fishing, shellfishing, trapping, and hunting as the principle forms of recreation as well as income. Fishing and waterfowl hunting continue to be major recreational activities and industries throughout the study area. State and federal waterfowl refuges, including Blackwater NWR and Fishing Bay Waterfowl Management Area, are important for maintaining and protecting the waterfowl resource. State-managed public hunting areas within the study area include Maryland's Taylors Island, Deals Island, South Marsh Island, LeCompte, Linkwood, Fishing Bay, Ellis Bay, Nanticoke, and Idylwild Wildlife Management Areas; and Delaware's Nanticoke Wildlife Area.

In 1985, residents and landowners established a new waterfowl-oriented industry unique to Dorchester County: Regulated Shooting Areas (RSA's), which promote free-flying and flighted mallard release programs, and provide thousands of hours of recreational hunting. According to Resource Management, Inc., more than $22 million have been invested in land purchases for RSAs, and an additional $109 million have been spent on improvements and equipment since 1985. At least 115 jobs developed as a result of the RSA's. The real estate market reflects the importance of conservation and recreational hunting properties to the Dorchester County economy.

Fur trapping is a source of both recreation and supplemental income to some residents, particularly watermen and farmers. Trappers in Maryland have historically earned about a million dollars a year, although that amount has continually been reduced each year as the demand for fur products diminishes.

Other forms of recreation that contribute to the local economy are fishing and crabbing, sailing on the Bay, boating on the Blackwater and Nanticoke rivers and their tributaries, swimming, picnicking, biking, and golfing. A rapidly

growing segment of the population, whose contribution to the economy also is substantial, engage in wildlife observation and photography.

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 wood working and carving wooden decoys.

The necessity of boats to island life makes boating an easily accessible recreation activity. Seasonal residents, day-tripping tourists, and transient boaters may be more likely to enjoy recreational boating, touring, bird-watching, and sport fishing in the island waters. However, both islanders and visitors find the marshes and waterways of the island a magnet for hunting, fishing, observing nature, and the kind of poking around that the locals call “proging.”

Tourists arrive on the island by private boats or on the ferries that cross from the Eastern shore at Crisfield or Point Lookout State Park, Maryland, or from Radville, Virginia, on the west shore of the Bay. There are limited transient docking facilities on the island, but lodging is available at two commercial bed and breakfasts (at Ewell and Tylerton) and at several private homes. Several restaurants, generally catering to group tours arriving on the ferries, are located near the harbor at Ewell. Most facilities for visitors, such as the bed and breakfasts and the tourist center at Ewell, are open during the summer tourist season or by prior arrangement. Ferry access to the island during the winter is limited by fewer scheduled trips and by weather conditions. In spite of the logistical constraints, approximately 40,000 tourists visit Smith Island each year (based on conversations with residents), drawn by its natural beauty and quiet charm.

The planning and tourism offices of Somerset County have plans to promote eco- and heritage tourism in the county, including Smith Island. The Crisfield and Smith Island Cultural Alliance was instrumental in the construction of the Smith Island Tourist Center at Ewell and has plans for additional development at the center.

Recreational Opportunities on the Refuge Complex

The following principles have guided our management of public use on the Refuge Complex.

1. Promote the station message, thereby enabling the visitor to have a more enjoyable experience and perhaps helping to reduce the impacts on other wildlife areas.

2. Provide environmental education and training for teachers and students, incorporating the station message.

3. Increase self-service opportunities to better educate the public and promote the station message (especially, print an adequate quantity of brochures).

4. Provide compatible opportunities for wildlife observation, photography, hunting, and fishing.

5. Provide professionally produced interpretive information at appropriate locations.

6. Improve the training of staff and volunteers to enable them to provide quality interpretive experiences for the public that convey the station message.

7. Maintain and improve visitor facilities to ensure that high quality experiences of different levels and abilities that are safe, enjoyable, and educational are available to the public.

8. Conduct effective outreach and work with State and local organizations to provide recreational facilities that enable the visitor to enjoy the refuge without adversely affecting either wildlife or wildlife habitat.

Blackwater NWR

In order to protect sensitive island ecosystems and wildlife in the Island Refuges, public use generally is confined to Blackwater NWR. The Island Refuges are closed to public use, except for limited interpretive tours conducted by refuge staff and self-guided interpretation at the Martin NWR visitor contact station in Ewell on Smith Island.

In 2000, Blackwater NWR provided more than 505,000 visitors the opportunity to learn about and view waterfowl, endangered species, and migratory birds. Approximately 70,000 of these visitors annually receive information from the Visitor Center; up to 100,000 observe and photograph wildlife from the Wildlife Drive; and 25,000 use the nature trails.

Wildlife observation and photography.—The interest in wildlife viewing and education is evident at Blackwater NWR. According to the Dorchester County Department of Tourism, Blackwater NWR visitors spend an estimated $15 million in the Dorchester County economy annually, having a tremendous impact on local restaurants, hotels, retail merchants, and other attractions. This is based on an average annual visitation number of 100,000 to Blackwater NWR, excluding donations and gift shop totals, and the Eastern Shore's average visitor spending of $150.00 a day on hotels, meals, and retail items.

Environmental education and interpretive programs.—Blackwater NWR provides structured environmental education programs for 1,700 students and scouts a year. With funding and assistance from the Friends of Blackwater, an environmental education manual is being developed to meet the requirements of the school systems. A Visitor Center with exhibits, films, and information desk and gift shop provide education and interpretation materials about wildlife recreational activities to the visitors. Current Blackwater leaflets, consisting of a general brochure, bird list, reptile and amphibians list, mammals list, Wildlife Drive guide, endangered species guide, interpretive leaflet for the Marsh Edge Trail, Friends of Blackwater brochure, handout on entrance fees, deer hunt information and maps, and a brochure on the management of Canada geese, are routinely distributed to the public.

The Friends of Blackwater issue a quarterly newsletter. Audio visual programs are offered to the public at the visitor center. The only leaflet available for the Island Refuges is the general brochure for Martin NWR. An active volunteer program of 100 volunteers contributes more than 11,000 hours annually, mostly to help staff the Visitor Center.

A self-guided, paved, 6½–mile interpretive tour on the Wildlife Drive is available for wildlife observation and photography. This auto tour route is interpreted, with numbered stops and accompanying leaflet or an audio tape. A self-guided interpretive tour of the Marsh Edge Trail is also available. This •–mile accessible paved trail is interpreted, with numbered stops and accompanying leaflet. Four interpretive kiosks with a variety of interpretive panels to orient visitors and describe management programs are located around the Wildlife Drive. The Woods Trail is a ½–mile trail that offers opportunities for wildlife and wildlands observation.

Hunting opportunities.—Big game hunting for white-tailed and sika deer is permitted for 42 days each year on Blackwater NWR (35 days of archery, a 1-day special youth-only shotgun hunt, 2 days of muzzle-loading rifle or shotgun hunting, and 4 days of shotgun hunting) to help reduce neighboring crop depredation by refuge deer and to provide public recreation. No other hunting presently is available for the public on the Refuge Complex.

Blackwater NWR provided hunting opportunities for more than 3,000 deer hunters in 2000. The $25,000 collected annually in the hunt program is used to hire a hunt coordinator and maintain parking areas and signs. Sportsmen also contribute substantially to the economy of an area through local purchases of gas, food, lodging, and supplies. Trapping is conducted on the refuge in an effort to control nutria and muskrat populations. Trapping income from the refuge is estimated to contribute approximately $30,000 to the local economy annually.

Fishing opportunities.—Limited commercial fishing on Blackwater NWR was authorized under special use permits until 1989, when the program was stopped to minimize disturbance to wintering waterfowl. The navigable waters of Martin NWR are not under the control of the Service, and remain open to commercial fishermen, who are dependent on the rich marine resources of the Bay.

Recreational fishing is permitted on Blackwater NWR during the summer months, and annual visits average approximately 1,700. The refuge closes to boating October 1–March 31 for waterfowl protection, limiting fishing opportunities during other periods of the year to two bridges on public roadways where there are no parking facilities.

Chesapeake Island Refuges

Because of the limited size of most of the islands, difficulty of access, and the high degree of sensitivity of most of their wildlife species to human disturbance, public use is severely limited. The Middleton House at Ewell serves as a contact station for the refuges, and provides an opportunity to inform 40,000 visitors annually about objectives and management.

The Karen Noonan Environmental Education Center on the Bishops Head Division is operated and maintained by the Chesapeake Bay Foundation. Approximately 1,000 students and teachers annually utilize the Bishops Head Division, Watts Island, Martin NWR, and Barren Island Division for environmental education subject to the conditions of an existing Memorandum of Understanding.

Susquehanna NWR is not open to the public. Access to Battery Island is difficult, and its 1-acre area offers little opportunity for public use. Except for special environmental education activities mentioned above, the islands are closed to the general public due to their environmental sensitivity and difficult access.

Other Refuge Complex Uses

The Refuge Complex now conducts or cooperates with research on DFS, mute swans, tundra swans, trumpeter swans, Canada geese, snow geese, effects of released mallard programs, marsh loss, water quality, nutria damage and control, land subsidence, fire management, phragmites, wetland restoration, sea level rise, salt water intrusion, and many other management issues. Monitoring and surveys conducted by refuge staff, cooperators, and volunteers include waterfowl, reptiles and amphibians, DFS, eagle, breeding bird, shorebird, muskrat, deer, owl, and moist-soil vegetation surveys; DFS and nutria mark and recapture; blue bird and wood duck nest box use and production; water quality monitoring; waterfowl, osprey, colonial bird, and barn owl banding; and, gypsy moth and pine beetle egg mass and defoliation surveys.

Chapter 4. Management Direction

USFWS

Flooding is a common occurrence on the refuge due to low elevation

Introduction

Our management direction is based on the tenets of conservation biology, and emphasizes biological diversity. It takes advantage of the emphasis in the NWRSIA on conserving biodiversity through sound science. The NWRSIA mandates change, and this plan will bring that change to the Refuge Complex by maintaining its biological diversity and environmental health, significantly improving its existing resource inventorying and monitoring program, and expanding it to include new areas: important, ecologically sensitive areas that require protection. Our plan also focuses on improving our ability to accommodate priority public uses, when they are compatible with refuge purposes and the mission of the Refuge System.

Conservation biology has been practiced for centuries. It derives from various fields, including population biology, genetics, forest and wildlife management, ecology, economics, anthropology, and philosophy. The science of conservation biology focuses on the protection of biological diversity at all levels, including genes, populations, species, habitats, ecosystems, and landscapes, as well as the maintenance of ecological processes, such as natural selection, natural disturbance, and hydrologic flow. Current thinking differs from traditional resource conservation. It is driven not by utilitarian, single-species issues, but by the desire to conserve the biological components and ecological processes of entire ecosystems.

Ecoregional planning (or reserve selection), a subset of the conservation biology field, involves working at large geographic scales to systematically determine areas of biodiversity significance and thus, conservation importance. In contrast, site planning (or reserve design) focuses on the best methods to achieve conservation success at a particular site or area.

Refuge Complex Vision Statement

> "The Chesapeake Marshlands National Wildlife Refuge Complex will provide the foundation for the creation of the most complete network of protected lands in our Nation's largest estuary. This assemblage of diverse island, wetland, upland, and aquatic habitats will represent all the biotic communities unique to the upper and middle Chesapeake Bay. The Refuge Complex will continue to be internationally and nationally renowned for its wetland habitats, which sustain significant populations of waterfowl and other Service trust resources. These refuges will expand their role in protecting, restoring, and managing the full range of natural processes, community types, and native plants and animals, making them anchors for biological diversity and ecosystem-level conservation locally, regionally, and within the National Wildlife Refuge System. The Refuge Complex will serve as a leader in the strategic acquisition or protection of important habitats within the watershed, and as a center to showcase the best science and technology used for wildlife conservation.
>
> The Refuge Complex will demonstrate the importance of the natural world to the quality of human life; the value of, and need for, fish and wildlife management; and the human role in preserving and enhancing wildlife habitat. The Refuge Complex will forge partnerships to address the natural, historical, and cultural resource issues of the region. Local communities will recognize these refuges as national treasures, and actively participate in their stewardship. The Refuge Complex will raise public awareness and understanding of the Refuge System mission by providing clean, welcoming, safe, and accessible opportunities and facilities for compatible, high-quality, wildlife-oriented experiences. In collaboration with many partners, a wide range of innovative, stimulating, general public and environmental education programs and activities will be provided to diverse audiences.
>
> By accomplishing this vision, these refuges will ensure healthy fish, wildlife, and plant resources for people to enjoy today and an enduring legacy for generations to come."

Refuge Complex Goals

The following broad goals of the Refuge Complex support the mission of the Refuge System, the purposes for which its refuges were established and other guiding laws and plans. Along with the vision statement for the Refuge Complex, they establish management direction.

Each goal is supported by measurable, achievable objectives and specific strategies and tasks needed to accomplish them. We intend to accomplish these goals in a 10- to 15-year time frame. The availability of funding may affect their actual implementation.

Goal 1. Protect and enhance Service trust resources and other species and habitats of special concern.

Goal 2. Maintain a healthy and diverse ecosystem with a full range of natural processes, natural community types, and the full spectrum of native plants and animals to pass on to future generations of Americans.

Goal 3. In collaboration with our conservation partners, create the most complete network of protected lands within the Chesapeake Bay Watershed.

Goal 4. Develop and implement quality scientific research, environmental education, and wildlife recreation programs that raise public awareness and are compatible with refuge purposes.

Goal 5. Ensure that staffing, facilities, resource protection, and infrastructure are developed commensurate with plan implementation.

Blackwater National Wildlife Refuge

Concepts Used in Developing Management Strategies

Land Protection.—On July 17, 1995, the Director approved a Preliminary Project Proposal to study protecting an additional 17,500 acres on Blackwater NWR, of which we acquired 2,186 acres by categorical exclusion. On July 25, 1995, the Director approved the study of an additional 16,000 acres on the Nanticoke River. See appendix B, "Land Protection Plan."

We will continue to pursue the protection of those lands and waters through a variety of actions, including fee title acquisitions, easements, and cooperative agreements. When we have assembled an adequate block of acreage along the Nanticoke River, we will manage that area as another division of the Refuge Complex.

We will also continue to identify within the focus area key private lands that will produce the greatest strategic gains in achieving our management goals and objectives outlined below. For example, we will prioritize the acquisition of forest lands in or near the core areas we have defined as providing optimal breeding habitat for forest birds. And, we will acquire inholdings from willing sellers as opportunities arise. [See chapter 1, figures 1.1 and 1.2.]

The private property rights of landowners to own, use, and manage their lands and natural resources will continue to be recognized and respected. A primary reason many of the Service's trust resources are concentrated in the Blackwater and Nanticoke focus areas is because of historical land management by private landowners. The Service recognizes that private lands can be well managed to maintain their current ecological and economical benefits. However, should private landowners within these focus areas subsequently decide to develop their properties and thus potentially adversely affect areas important to Service trust resources, conservation interests will be pursued. The acquisition of conservation interests in these lands will maintain current management programs and activities such as cropland and forest land management when these practices are compatible with refuge purposes and System mission, and done in accordance with approved management plans. Our management activities will be designed to complement the resources and rights of adjacent landowners.

Fish, Wildlife, and Habitat Management.—We will significantly expand the Complex-wide Resource Inventory and Monitoring Program, and will emphasize the tenets of conservation biology and ecosystem processes in designing and implementing our management programs. Also, we will implement programs for optimizing biological integrity and ecosystem health in the context of refuge purposes.

We will deploy a variety of active and passive management programs to accomplish habitat- and population-based goals and objectives, including intensively managed moist soil units (MSU) and croplands; development and implementation of a forest management program; active intervention to address exotic, invasive, and injurious

species; and landscape-level restoration.
Most of the fish, wildlife, and habitat management activities that we will implement under this CCP have routinely been implemented at Blackwater Refuge with the exception of active forest management. Therefore, a description of the forest management program is included as follows to clarify the general management principles and objectives.

The primary objective of forest management on refuges is to develop, manage, and perpetuate the diversity of indigenous wildlife populations needed to meet refuge objectives. The specific objectives of the NWRS forest management program, as defined in the Refuge Manual 6 RM 3, are to: 1) Provide habitat and protection for those species of plants and animals indigenous to the refuge that are officially listed by the Service or States as being threatened or endangered; 2) Provide habitat for waterfowl and other wildlife species; and 3) Provide compatible opportunities for wildlife-oriented recreation, environmental education, and interpretive/demonstration activities.

The diversity of forested habitats harboring many of our Trust Resources exists today as a result of past land management practices, including silviculture. Securing the conservation and restoration of Trust Resources will require actively fostering a mosaic of species composition and age-classes of forested habitats and seeking to improve the health of our existing forests. To provide Trust Resources with their needed habitats through time, the Refuge will embrace continued silvicultural activities consistent with the tenets of sustainable forestry (SFI and SCI) where compatible with Service mission and refuge purposes as mandated by the NWRSIA. In many cases, selected management strategies will also include reforestation of prior converted wetlands that were cleared, drained, and converted to agriculture.

Stewardship of forest habitats managed by the Refuge will be guided via the implementation of a written forest management plan providing for the conservation of desired habitat attributes. This will necessarily include provisions for the continuous production of suitable forest habitats utilizing sound silvicultural practices that help to achieve wildlife management objectives and refuge purposes, are ecologically responsible, respectful of cultural customs and uses, and economically contributory to the local communities.

The care and maintenance of many of our Trust Resources (particularly forest interior dwelling migratory birds and endangered species like the Delmarva fox squirrel and bald eagle) depend upon utilizing silvicultural prescriptions, which in turn require a cadre of professional forest and biological practitioners working collaboratively within both the public and private sectors to provide these services. Although not a primary objective, economics is recognized as an important part of every management program. Commercial harvest is an important tool for accomplishing forest habitat management because it reduces the funds and manpower needed to attain wildlife and habitat management objectives. Markets for forest products provide the economic incentives supporting the infrastructure of forestry practitioners; thus, the Service recognizes the importance of the forest industry in attaining desired habitat conditions on Refuge lands. As one of the largest forest landowners in the local community, the Refuge recognizes that actively participating in forest markets directly supports the infrastructure of forest practitioners, which are key partners in maintaining habitats for Trust Resources.

The Service also recognizes that private forest lands can be well managed to maintain their ecological and economic benefits. Future land protection efforts by the Refuge beyond the current boundaries will be cognizant of private landowner forest stewardship responsibilities and the importance of maintaining silvicultural practices and techniques defined in this CCP. When acquiring interests in private lands, such as implementing conservation agreements, we will initiate or continue forest management practices to conserve Trust Resources and enhance resource attributes, particularly in forests identified as having high conservation values in our identified focus areas.

The following management principles, as defined in 6 RM 3, will guide the planning and implementation of our forest management program:

1. Management operations will serve to meet wildlife habitat needs.
2. Provide a variety of successional stages, forest types, and seral stages within types.
3. Aesthetics will be considered and made part of forest management decisions.
4. Cultural resources will be protected and preserved.
5. Sufficient snags and den trees shall be made available.
6. Efforts will be taken to minimize the risk of wildfire ignitions.

7. Management practices will be consistent with available funds and manpower. Commercial harvest will be used as an available tool to accomplish management utilizing local industry resources.

We will write the forest management plan (FMP) in a collaborative inter-agency/interdisciplinary process. The goal of the forest management plan will be to meet NWRS mission and refuge purposes through accomplishing the objectives defined in this CCP and practicing the tenants of sustainable forestry and stewardship. We will routinely review the FMP to incorporate results of monitoring and scientific investigations, and respond as appropriate to changing environmental, social, and economic conditions as directed by NEPA.

All forest management activities will be strictly monitored to maintain compliance with best management practices and to conserve biological diversity and associated wildlife values, water resources, soils, and unique and fragile ecosystems and landscapes.

Public Use.—Outreach is two-way communication between us and the public to establish mutual understanding and promote public involvement in improving the joint stewardship of our natural resources. One concept that will guide our outreach is that public awareness of the Service, its mission, and its role in wildlife conservation is needed for the American public to appreciate and support our effective management of the Refuge Complex and its refuges. To improve that management, we must build a strong base of public understanding and support, by educating people about these refuges, their purposes and goals in a clear refuge message. The following concepts will guide our management of public use.

1. Promote the refuge message in providing visitors a more enjoyable experience and helping reduce visitor impacts on other wildlife areas.

2. Provide environmental education and training that incorporates the refuge message for teachers and students.

3. Increase opportunities to help the public to educate itself, such as printing an adequate quantity of brochures that incorporate the refuge message.

4. Provide compatible opportunities for wildlife observation, photography, hunting, and fishing.

5. Provide professionally produced interpretive information at appropriate locations.

6. Improve staff and volunteer training to enable them to provide the public quality interpretive experiences that convey the refuge message.

7. Maintain and improve visitor facilities to ensure that high quality, safe, enjoyable, and educational experiences of different levels and requiring different abilities are available.

8. Conduct effective outreach and work with State and local organizations to provide recreational facilities that enable visitors to enjoy the Refuge Complex without adversely affecting either wildlife or wildlife habitat.

9. Public uses will not interfere with important nesting or wintering seasons of listed species.

10. No public use activities will be permitted where public safety or trust resources are adversely affected.

We will improve existing public use opportunities and develop more environmental education and interpretation and wildlife-dependent recreation, in conformance with “Fulfilling the Promise” and the Refuge System Administration Act. We will develop an environmental education manual and teachers’ workshops; build an environmental education center; remodel and enlarge existing structures dedicated to public use; modernize exhibits; and build information kiosks, observation sites and decks, interpretive trails, photo blinds, and an accessible fishing pier. We also will expand hunting, fishing, and other wildlife-dependent recreational opportunities.

We will expand our outreach to build a stronger base of public understanding and support. We will develop better relationships with the media, local governments, and community organizations; participate in public events; work with the Friends of Blackwater; and install a travelers' information radio station.

Goals, Objectives, Strategies, and Monitoring Elements

Goal 1. Protect and enhance Service trust resources and other species and habitats of special concern.

Subgoal 1. Provide habitats to sustain 10 percent of each of Maryland's wintering waterfowl populations of Atlantic Population (AP) Canada geese, snow geese, and dabbling ducks (as measured by the Midwinter Waterfowl Inventory).

Objective 1.1.1. Monitor wintering waterfowl populations.

Basis of the objective.—Blackwater NWR is managed primarily for wintering waterfowl. Since 1955, 6 percent [SE = 0.6, n = 44] of Maryland's Canada goose, snow goose, and dabbling duck populations counted during the annual Midwinter Waterfowl Inventory have been on Blackwater NWR. To support the objectives of the NAWMP, the Chesapeake Bay Program Waterfowl Management Plan (2000), and Maryland's Canada Goose Management Program, the refuge must maintain a credible monitoring program to assess the efficacy of management actions and to determine the contribution of Blackwater NWR to Maryland's waterfowl populations.

Strategies to achieve the objective.—Blackwater NWR will continue to conduct three surveys of wintering waterfowl populations at three different spatial scales. The Midwinter Waterfowl Inventory (MWI) will be flown once annually, supplemented by bimonthly aerial surveys of the refuge and weekly ground counts of the impoundments, croplands, and adjacent river.

Monitoring element.—The percentage of AP Canada geese, snow geese, and dabbling ducks.

Objective 1.1.2. Restore emergent marsh on Blackwater NWR to 1933 coverage level by 2017

Basis of the objective.—Blackwater has lost more than 7,000 acres of emergent wetlands since its establishment as a national wildlife refuge in 1933. Most of that loss has occurred in the three-square (*Schoenoplectus americanus*) brackish marsh at the confluence of the Little Blackwater and Blackwater rivers, but is also now progressing upstream and downstream. That unusually high rate of wetland loss is likely the result of several confounding factors, including sea-level rise, land subsidence, saltwater intrusion, severely modified hydrology, and excessive herbivory.

This emergent marsh once provided significant breeding habitats for blue-winged teal and American black ducks, and foraging habitats for wintering populations of geese and dabbling ducks. The open water that has displaced the lost wetlands is now used primarily by waterfowl as a disturbance-free rest area during migration and winter and by resident populations of resident Canada geese as a safe place to molt during the summer. It has little value for diving ducks, presumably because its shallow, flocculent bottom precludes high densities of submerged aquatic vegetation (SAV) and invertebrates.

Strategies to achieve the objective.—We will develop a comprehensive Habitat Management Plan by 2008 that will detail options for maintaining, restoring, and enhancing marsh habitats. Restoration strategies to be assessed will include plugging Stewart's Canal to reduce saltwater intrusion, modifying Shorter's Wharf Road to allow sheet flow, implementing recommendations from the Nutria Pilot Study to reduce nutria herbivory, implementing the Integrated Wildlife Damage Management Plan for resident Canada geese, maintaining the muskrat trapping and nutria rebate program, riprapping the pine islands, reducing sediment load run-off into the upper watersheds, using thin-layer soil deposition, and evaluating more substantive spoil deposition. Strategies for maintaining and improving floral composition will include the use of prescribed fire to affect regrowth vigor and species composition, the use of pesticides to control invasive flora, and replanting in conjunction with techniques such as thin-layer soil deposition.

Monitoring element.—Acreage of emergent marsh restored.

Objective 1.1.3. Manage approximately of 420 acres in croplands on Blackwater NWR, thus reducing current cropland acreage by 25 percent by 2017.

Basis of the objective.—Due to wetland loss and degradation, natural food resources are inadequate to increase or even sustain the current levels of waterfowl use on Blackwater NWR. Furthermore, very few "hot foods" (e.g., corn and sorghum, which are high in carbohydrates and energy) are available off-refuge; those that are available are consumed early. When birds have to travel long distances to seek food off the refuge in severe winter weather, their energy reserves are quickly depleted. Consequently, the refuge plants row crops and cool-season grasses or forbs each year, presently as forced-account, to sustain wintering migratory waterfowl during critical periods of nutritional and physical stress. High-protein cover crops of Ladino clover and buckwheat, over-seeded with winter wheat, receive heavy waterfowl use the entire winter. Sorghum and corn provide high carbohydrates during midwinter and periods of extreme weather when food sources generally are unavailable. Japanese millet is planted in low elevation fields and in some MSUs, where early flooding in the autumn is likely. Small acreages also are planted in sunflowers for migrating waterfowl and granivorous passerines.

The forest management portion of the Habitat Management Plan recommends the restoration of selected, formerly converted wetlands from agricultural use to forested habitats (i.e., reforestation). We will convert some formerly converted wetlands from agricultural use to MSUs, due to soil types with poor drainage characteristics (see objective 1.1.4., below). Consequently, the acreage under cropland management will be reduced by 25 percent. Contractual planting of corn and sorghum crops with force account planting of the cool season grasses and forbs is recommended, because it minimizes labor and equipment on the part of the refuge while retaining the most nutritious composition of croplands to meet the seasonal needs of waterfowl. Should funding not be available for contractual planting and forced-account responsibilities, cooperative farming will be implemented.

Strategies to achieve the objective.—We will manage 420 acres of cropland by contractual planting of 100 to 120 acres in hot foods and forced-account planting, and maintaining 300 to 320 acres in cool season grasses and forbs. The croplands will be divided into one-quarter hot foods and three-quarters high-protein browse, consisting of Ladino clover, winter wheat, buckwheat, crimson clover, and annual rye. Small acreages of sunflowers will also be planted for granivorous passerines, particularly mourning doves. We will leave all crops unharvested for wintering waterfowl and other wildlife.

If funding is insufficient, we will implement cooperative farming on a 75- to 25-percent share of the crops produced. Additional strategies will include continuing to implement the Integrated Wildlife Damage Management Plan for resident Canada geese to reduce cropland damage; developing Farm Plans, including filter strips; controlling sediment erosion; using integrated pest management; using nutrient management planning; rotating crops; and using other best management practices. [Consult the Cropland Management Program for a more thorough description of the exact procedures and differences among cooperative farming programs and contractual or force account programs.] We will evaluate cropland management for newly acquired lands on a tract-by-tract basis, regarding the highest and best use consistent with the Habitat Management Plan.

Monitoring element.—Acres of crops, cool-season grasses, or forbs available for waterfowl at the onset of the fall migration (approximately 15 September).

Objective 1.1.4. Manage a minimum of 460 acres of impoundments on Blackwater NWR for moist soil management, thus increasing moist soil acreage by 25 percent by 2017.

Basis of the objective – Native herbaceous vegetation adapted to germination in hydric soils (i.e., moist-soil plants) provide waterfowl with nutritional resources, including essential amino acids, vitamins, and minerals that occur only in small amounts or are absent in other foods. These elements are essential for waterfowl to successfully complete aspects of the annual cycle such as molt and reproduction. Moist-soil vegetation also has the advantages of consistent production of foods across years with varying water availability, low management costs, high tolerance to diverse environmental conditions, and low deterioration rates of seeds after flooding.

MSU also promote invertebrate production. Invertebrates provide the critical protein-rich food resources required by pre-breeding and breeding female ducks, newly hatched waterfowl, and molting ducks and shorebirds. Due to the high value of MSU to waterfowl, shorebirds, and other water birds, additional MSU will be constructed on formerly converted wetlands with poor soil characteristics; i.e., poor drainage. Additionally, the existing MSU infrastructure will be improved to more effectively manage water levels.

Strategies to achieve the objective.—When implementing moist soil management, pool drawdowns typically would occur between mid-March and early June, depending on the wildlife objectives and moist soil plant or invertebrate response desired. Drawdown would begin in most pools first by gravity flow, but pumping often may be required in most of the impoundments to remove all the water. We would maintain several permanent and seasonal pumping stations, using gasoline, diesel, and electric pumps. Rates of drawdown can be critical and, depending on the pool bottom topography and soil type or organic content, can either occur rapidly or must be prolonged. We would complete all drawdowns by mid-June, and would keep pool bottoms as moist as weather conditions will allow, to facilitate the germination, growth, and production of a wide diversity of emergent moist soil plants, such as smartweed, beggartick, red-root Cyperus, Panicum, Walters' and barnyard millets, dwarf spike rush, and others.

We would monitor and record water levels, pH, conductivity, and salinity weekly during the growing season and biweekly during periods of flooding. We will describe exact water level management plans in our Annual Water Management Program, which we would use as an annual management guide (rainfall-dependent).

We will convert an additional 89 acres of PC wetlands to moist soil management. Electric pumps will be installed in pool 3 and pool 5 to facilitate flooding and drawdowns. Three water control structures will be installed between pools 3A–3B, 3B–3C, and 5A–5B. A water control structure will be installed to replace the 12" concrete pipe that now fills pool 4. Additional strategies include continued implementation of the Integrated Wildlife Damage Management Plan for resident Canada geese.

Future moist soil management units will be developed on newly acquired lands if they are appropriate for helping to achieve refuge purposes, goals, and objectives.

Monitoring element.—Acres of MSU that have >75-percent cover of vegetation that produces good waterfowl foods (see Martin and Uhler 1951) at the onset of migration (15 September).

Objective 1.1.5. By 2007, determine existing American black duck production and preferred habitat types.

Basis of the objective.—The American black duck is a National Species of Special Emphasis. It ranks on the Watch List in the Partners-in-Flight Mid-Atlantic Coastal Plain Bird Conservation Plan (1999) and is a species of emphasis in the Chesapeake Bay Program Waterfowl Management Plan (2000). American black ducks bred in high densities at Blackwater in the 1930s, but more recently, the perception is that both pair densities and brood production have been low. It is not apparent what proportion of the breeding population is nesting in emergent vs. palustrine forested wetlands. There is a clear need to develop an initiative with the explicit goal of implementing an integrated approach to the research and management of American black ducks on the Refuge Complex.

Strategies to achieve the objective.—The black duck initiative will seek collaborative efforts among these stake holders and others to develop funding for studies to assess black duck productivity, nest predation rates, and habitat use on the Refuge Complex. Strategies will likely involve nest monitoring, brood surveys, and a radio telemetry study of nesting females. Subsequent management to maintain and enhance black duck production will be based on recommendations from these studies and others identified in the Black Duck Atlantic Coast Joint Venture Plan and the Chesapeake Bay Program Waterfowl Management Plan 2000.

Monitoring element.—Partnership and funding for the initiative for American black ducks, and continued participation in the Midwinter Waterfowl Inventory.

Objective 1.1.6. Maintain natural nesting habitats for wood ducks by 2017

Basis of the objective.—The wood duck is a National Species of Special Emphasis. Blackwater has historically contributed to local and regional populations of wood ducks by maintaining 5,000 acres of palustrine wetlands.

Strategies to achieve the objective.—The refuge will continue to maintain 5,000 acres of palustrine forested wetlands; this acreage will increase as new lands are acquired. Silvicultural treatments (including contract sales and TSI) specifically will retain 2 to 5 snags of at least 12" DBH per acre to ensure a good distribution of natural cavities on the refuge. We will eliminate the existing wood duck nest boxes, except for 15 that we will maintain for environmental education along the Wildlife Drive. We will continue to conduct fall brood surveys and roost counts.
Monitoring element.—Acreage of palustrine forest maintained.

Objective 1.1.7. Determine the regional significance of the lesser snow goose population by 2010.

Basis of the objective.—The lesser snow goose (*Anser c. caerulescens*) is primarily a migrant in the mid-continental and Pacific flyways (Bellrose 1976). However, a relatively small proportion of the continental population migrates south in the fall to the Chesapeake Bay, Currituck Sound, and adjacent waters of the Atlantic Coast. An unusually high proportion of this regional population at Blackwater NWR is the blue phase, suggesting a genetically distinct population. Blackwater NWR has been a traditional wintering site for a significant portion of this population since 1934–35. Based on aerial surveys over the past decade, 2500–3500 lesser snow geese have routinely wintered on Blackwater NWR, with counts as high as 6,500 geese during peak migration. Other than the occasional vagrant, all other refuges on the mid-Atlantic coastal plain support greater snow geese (*Anser c. atlantica*). It is apparent that the population at Blackwater NWR is unique from both a continental and regional perspective, and may contribute to the genetic diversity of the continental lesser snow goose population.

Strategies to achieve the objective.—We will develop a study of the lesser snow goose population at Blackwater NWR with the two primary objectives of determining (via satellite telemetry) the migration corridor and breeding grounds, and determining the genetic uniqueness (by contrasting genetic markers) of this population. The importance of this study is that confirmation of a genetically distinct sub-population of lesser snow geese will clearly demonstrate the need to revise current USFWS plans to reduce snow goose (regardless of subspecific status) populations in Region 5.

Monitoring element.—Generate funding and complete the study identified above; implement subsequent recommendations.

Objective 1.1.8. By 2011, develop programs to prevent the loss or degradation of habitats and develop programs and actions to restore and enhance waterfowl habitats within the Nanticoke protection area.

Basis of the objective.—Although waterfowl habitats in the Nanticoke watershed are considered to be in relatively good ecological health, several factors are adversely affecting these wetlands' functions and values. With economies based in agriculture, forestry, fisheries, and tourism, the Nanticoke watershed has not yet experienced the adverse impacts from development in the intensity felt in other tributaries of the Chesapeake. However, due to poor land use practices, some habitat degradation has been documented, such as sedimentation, eutrophication, conversion, drainage, and channelization.

Strategies to achieve the objective.—We will restore wetland functions and values by restoring riparian systems, replanting degraded wetlands with native plant species, re-establishing SAV beds, controlling exotic or invasive species, and (where appropriate) using structural devices to restore natural hydrology and control salinity. We will assess the effects of hydrological and water quality changes by establishing a water quality monitoring program to evaluate the effects of upstream sources of pollutants on division resources.

Hydrological modeling may be considered for the Nanticoke River and its tributaries to determine the potential changes in habitat conditions over time from the compounding effects of land subsidence, sea-level rise, and saltwater intrusion. Eutrophication of the system is occurring, and any efforts to address the effects of excessive nutrients will require extensive coordination and planning with partners and stakeholders. Also, the effects of channeling and other hydrological modifications on the Nanticoke River's main stem and its tributaries need to be inventoried and mapped.

Another strategy is to determine the management options for formerly converted wetlands. Reforestation of prior converted (PC) forested wetlands and other drained wetlands will play a crucial role in establishing and restoring waterfowl habitats. However, some areas will be transformed into intensively managed moist soil systems, or

maintained in cropland. Our Resource Inventory and Monitoring Plan and Habitat Management Plan may identify other restoration and enhancement opportunities.

Monitoring element.—Seasonal acreage of each wetland habitat type; miles of restored riparian forests; acreage, number and type of restoration activities; acres of SAV beds planted.

Subgoal 2. Provide habitats that support Neotropical migratory songbirds, emphasizing forest interior dwelling (FID) species.

Objective 1.2.1. Establish, manage, and enhance a minimum of seven mature forest cores on Blackwater NWR that are 400 acres or more in size by 2017.

Basis of the objective.—Blackwater NWR now contains many of the large contiguous tracts of forested land remaining on the Delmarva Peninsula. Twenty-five species of FID birds potentially breed in the mid-Atlantic coastal plain (see "A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area," June 2000). Twenty of the 25 species are Neotropical migrants: species that nest in temperate North America and winter in Central and South America. The cerulean warbler, veery, and black-throated green warbler were eliminated from this list because they are unlikely to be breeding on Blackwater NWR (H. Armistead, D. Dawson, J. McCann, pers. comm). Consequently, 22 of these FIDs are potential breeders on Blackwater NWR, and 20 species have been documented during the breeding forestbird survey in the past 5 years (see chapter 3, table 3.8, "Twenty-two FIDs that potentially breed on Blackwater NWR").

Robbins, et al. (1989) suggest that, ideally, management should provide the highest probability of providing for the least common species in the forest ecosystem. Partners In Flight recognizes eight of the FID species as "globally significant" (PIF score >21). Eleven of the 22 FIDs are highly area-sensitive; that is, they seldom occur in small, heavily-disturbed or fragmented forests. These species are most vulnerable to forest loss, fragmentation, and overall habitat degradation and, consequently, the ones that the Refuge Complex has chosen to target. Most are rare or uncommon on the Maryland coastal plain and many have highly specialized breeding habitat requirements. In fact, two of these species (broad-winged hawk and brown creeper) only recently were recognized as breeders on the Maryland coastal plain (Robbins and Blom 1996). According to "A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area" (June 2000), a forest tract is considered to be at least marginal FIDS habitat if either of these two conditions is satisfied: (1) at least 4 of the 22 species are present with a probable or confirmed breeding status or, (2) at least 1 of the 11 area-sensitive species is present with probable or confirmed breeding status.

Based on Robbins, et al. (1989) and the literature reviewed in Bushman and Therres (1988), a minimum patch size of 400 acres of mature forest provides potential breeding habitat for at least 5 of the 11 highly area-sensitive FIDs identified in chapter 3, table 3.8: Kentucky warbler, worm-eating warbler, hooded warbler, American redstart, and barred owl. In addition to those five area-sensitive species, 400 acres will provide potential breeding habitat for 10 other FID species, or, 15 species. This minimum habitat objective ensures that forested habitat on Blackwater will exceed the definition of marginal FID habitat established in "A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area" (June 2000). Conversely, an ideal patch size of 865 acres will provide potential breeding habitat for all 11 area-sensitive species, and all but one (northern parula) of the more tolerant FID species.

The overarching goal of the forest management program at Blackwater NWR (to be expanded to include additional acquisitions) will be to maintain and increase the size of contiguous, mature forest cores from a minimum of 400 acres to as many as 865 acres. Management strategies will include reforestation, strategic land acquisition, regrowth of cut over areas, timber stand improvement of existing stands, and regeneration cuts. The latter will, in most cases, target forest stands that are exhibiting signs of declining health; to a lesser extent, regeneration cuts will also be used to influence species and age class diversity. Silvicultural prescriptions for different forest types will follow those outlined by the FIDS and Forestry Task Force (June 1999), unless they specifically conflict with habitat requirements of the DFS.

Strategies to achieve the objective.—Using digital ortho-photography, we will identify large contiguous forested or previously forested tracts of land within the approved LPP for Blackwater NWR. Acquiring the most recent and

technologically advanced aerial imagery of lands within and around Refuge Complex lands and maintaining and managing a state of the art Geographic Information System will prove invaluable in protecting and managing trust resources and their habitats.

The most effective strategy for establishing all seven mature forest cores by 2017 or earlier will be to continue to acquire land within the approved LPP for Blackwater NWR. The acquisition of large contiguous tracts of mature forest will be the highest priority, along with privately owned tracts of land, directly adjacent to or within established cores. Acquiring large contiguous tracts of cleared land or immature forest will remain vital to the establishment of additional cores.

Reforestation of a minimum of 120 acres of PC forested wetlands and other non-forested lands (based on current landownership) will play a crucial role in creating and eventually expanding cores. Many large contiguous forest patches which are not yet large enough to be considered cores can be enhanced or increased by restoring adjacent agricultural or timber harvested lands back to mature forested habitats. Natural regeneration of cut-over areas is preferred, however, areas lacking natural regeneration, will be planted with a mix of native tree species which once dominated the site. PC areas adjacent to or within large contiguous forest patches or potential cores will be the highest priority for reforestation.

Aside from the actual planting, additional techniques associated with reforestation may include site preparation, weed control and subsequent thinning. Site preparation for the purpose of improving seed germination or planting efficacy may consist of soil scarification, prescribed burning, herbicide application and bedding. The control of undesirable vegetation (weeds) prior to or following tree planting or natural regeneration may be accomplished through application of approved selective herbicides, prescribed fire, or a variety of mechanical and manual methods. The reforestation of abandoned or unnecessary roads or the partial closure of the canopy over essential refuge roads, where applicable, will also aid in the establishment and enhancement of core areas.

Following more detailed inventories, a wide array of forest management practices will be utilized to help maintain or improve the quality or condition of all forest habitats, with special emphasis on establishing or maintaining large contiguous patches of mature trees, as well as a diversity of species. In order to ensure the long term existence of core areas, stand replacement or regeneration must be an ongoing management objective. A common characteristic of mature and over mature forest stands on Blackwater is generally a closed canopy and, as a result, a sparse understory. Also due to the closed canopy and lack of sunlight, there exists little or no natural regeneration of preferred tree species such as oak.

Therefore, we will use a variety of regeneration harvests to stimulate the germination of stored seeds or sprouting of root stocks for the purpose of replacing over-mature and stagnant trees within a stand. Supplemental planting may also be required in some areas. Harvesting methods which are performed for the purpose of eventual stand replacement include, but are not limited to, single tree selection, group selection, shelterwood, and strip and patch clearcuts. The specifics on when and where these activities will be performed cannot fully be determined until more detailed forest inventories are performed on a stand by stand basis. We will develop annual work plans for detailed management prescriptions, such as timber harvesting, timber stand improvement techniques (TSI), and planting.

TSI techniques, such as release cuttings, thinning, and prescribed fire, will also be used to maintain or enhance the growth and vigor of trees within the cores. TSI aims at reducing competition for resources, and targets undesirable and suppressed individuals for removal, thus improving the overall growing conditions for more preferred species. The resulting enhanced growing conditions will ensure forest stands reach the prerequisites for becoming core habitats at a much earlier stage. TSI will also be utilized to establish and maintain desired vertical structure, age class diversity, stem density and species composition.

Protecting these core areas and all other forested habitats from natural and anthropogenic forces is of utmost importance. Insect pests and diseases can have devastating impacts on forest habitats and significantly diminish the integrity of core areas. Blackwater NWR will continue to cooperate with the USFS to monitor for and manage forest insect pest populations, specifically gypsy moths. Integrated pest management strategies, such as annual egg mass surveys and aerial defoliation detection surveys, will continue to be performed by the USFS, with supplemental surveying and monitoring conducted by the forestry staff.

We will maintain a GIS-based monitoring and tracking system jointly with the USFS. We will implement control measures, such as the aerial application of biological insecticides such as Bt (*Bacillus thuringiensis*) or Gypcheck, based on survey results, recommendations, and funding (see objective 2.1.3, below). Performing TSI will also help to improve the health of the forest by reducing stress, therefore reducing its susceptibility to insect pest and disease outbreaks. We will implement more periodic ground and aerial surveys to monitor for additional insect or disease outbreaks. Once detected, the refuge will seek additional assistance from the USFS.

Wildfire prevention will play a vital role in the long term viability of respective cores. All wildfires which occur on or near refuge lands will be promptly contained and extinguished. Prescribed burning will be conducted on a periodic basis in areas of hazardous fuel loadings and in areas which have a high probability of ignition; i.e., road shoulders.

Monitoring element.—The number of 400-acre mature forest cores established by 2017.

Objective 1.2.2. Increase the size of four of the seven cores to a minimum of 865 acres by the year 2027.

Basis of the objective.—Same as objective 1.2.1. Additionally, a minimum core size of 865 acres will encompass at least 9 of the 11 area-sensitive FIDs that potentially breed on Blackwater NWR. These species will serve as both indicator and umbrella species for a wide range of forest benefits. When sufficient habitat is protected to sustain a diversity of forest birds, other important components and microhabitats of the forest will be encompassed and be protected. These may include the small, forested streams and headwaters critical for fish populations and the vernal pools necessary for the survival of amphibians.

Strategies to achieve the objective.—After cores are identified and delineated, the primary management focus will be to increase the size of the core to the optimal minimum size of 865 acres, which will provide potential habitats for at least 9 of the 11 area-sensitive FIDs. Remote sensing and GIS will again be used to identify potential areas and methods for expanding the cores. The primary focus will be on lands which are directly adjacent to, or within, the established core. Many of these lands are privately owned and will require acquisition. Acquiring parcels which are already forested and meet the minimum core criteria of being dominated by mature trees is the fastest and most effective means of increasing core size.

Lands that are already part of the refuge, but do not meet certain minimum core criteria, consist of prior converted wetlands (agricultural), recently harvested timberlands, salt killed areas, and immature stands. Prior converted forested wetlands that are critical to the expansion and enhancement of a core will be reforested and managed for the purpose of becoming part of a core. Those forested areas, which are now salt-stressed or highly susceptible to salt water intrusion, were not considered as part of existing or future cores.

We have designated a minimum of 120 acres of PC wetlands we now own to be reforested as soon as we can acquire funding. We will assess and intensively manage recently harvested areas to promote the establishment of preferred species. We prefer to use natural regeneration; however, in areas where natural regeneration is inadequate, supplemental planting will be used. Subsequent weed control and thinning may be used on all reforested or regenerated areas. Any salt-killed areas which have an impact on the expansion of core areas will be assessed for their potential for restoration. Adjacent or interior immature forest stands will be managed to improve the growth, vigor, and mast production of desired tree species to ensure a high quality addition to the core. Such management may include release cuttings, thinning, prescribed fire, and integrated pest management.

Monitoring element.—The number of mature forest cores that are a minimum of 865 acres by the year 2027.

Objective 1.2.3. Improve the quality of all cores by increasing their effective area by 20 percent within 10 years after they are established.

Basis of the objective.—Eleven of the 22 Mid-Atlantic Coastal Plain FID species listed in chapter 3, table 3.8, are highly area-sensitive and, consequently, just as sensitive to edge effects. An edge is the area where a forest meets a clearing. The forest edge is home to a number of other birds which may compete with the FIDs for food or even feed upon the FIDs eggs. Therefore, a 100-meter buffer was delineated from the core edge towards the interior of the core to determine the actual area within the core which can be considered habitats for area-sensitive FIDs. This variable is known as the “effective area” or “functional habitat”.

Strategies to achieve the objective.—The effective area of a core can be enhanced in various ways. The most obvious method is to increase the overall size of the core. However, this is only true if the parcels added to the core are shaped so that "effective area", not just area, is being added to the core. For example, a linear-shaped tract which is 200 meters or less in width will provide no additional effective area to the core, regardless of its overall size due to the influence of the 100-meter buffer associated with the edge. Another method is to ensure that non-core inholdings within an established core are managed in a way that they will eventually become part of the core. Gaps within cores significantly decrease the effective area due to the additional edge habitat they create. Once again these gaps may exist in the form of agricultural fields, timber harvests, areas of mortality, young forest stands or oversized roadbeds.

The methods for reclaiming these lands are similar to those in the previous objectives, and include reforestation, regeneration, and timber stand improvements. The actual shape of the core area also significantly influences the effective area. The optimal shape for maximizing effective area is one with the lowest perimeter-to-area ratio (i.e., a circle). Strategically acquiring, reforesting, and managing adjacent parcels of land to decrease perimeter length by smoothing out the boundary and forcing the shape away from being linear will increase a core's effective area.

Monitoring element.—Percent increase of effective area in each core.

Objective 1.2.4. Maintain or improve mean species richness of desired tree species within cores by 10 percent within 15 years after they are established.

Basis of the objective.—Maintaining a diverse mix of native pine and hardwood tree species will ensure that the needs of a much wider variety of FIDs and other wildlife are met. A diversity of tree species provides a greater mix of canopy structures available to FID species. A mix of both hard and soft mast-producing trees can ensure a nearly year-round food source for many species of wildlife. Species diversity also reduces the potential for host specific insect pests or diseases to wipe out an entire core. Due to the existence of the DFS, we will focus primarily on promoting the growth and dominance of loblolly pine and hard mast-producing species, such as oaks and beech.

Strategies to achieve the objective.—Desired composition and diversity of tree species within forest stands will be accomplished primarily by implementing a wide variety of silvicultural techniques, including but not limited to, timber stand improvements, regeneration harvests, prescribed fire, and herbicide application. TSI incorporates all intermediate cutting operations that require financial investment and do not involve removal of useful material. Intermediate cuttings are treatments conducted to modify or improve the growth of an existing crop of trees, but not to replace it with a new one. They involve the selective removal of suppressed, undesirable, or overcrowded vegetation to allow for the expansion of the crowns and root systems of desired trees.

Specific examples of these treatments include crop tree release, thinning, and improvement cuttings. A variation of those methods consists of the selective killing of undesirable trees by girdling them, injecting them with systemic herbicides, or aerially applying broadleaf-specific herbicides such as Arsenal™. These methods not only free up growing space and resources, but also provide nesting and feeding habitats for a variety of wildlife, primarily birds. The girdling of selected trees and allowing the dead snags to persist directly supports the Refuge Complex objectives for providing quality wood duck habitats.

Timber harvesting techniques that are aimed at replacing the existing stand with a new one can prove extremely effective in managing for desired species composition and diversity. Those harvest methods include seed tree, single tree and group selection, shelterwood, and strip or patch harvests. Salvage and sanitation cuts may be performed in areas impacted, or potentially impacted, by devastating insect or disease outbreaks. Post-harvest management, such as site preparation and weed control, is essential for ensuring the regeneration and establishment of desired species.

Prescribed fire is also an effective means of altering or managing the species composition within a forest stand during the early stages of development. Prescribed burning will be performed in applicable stands at early stages of development, while most tree species are still susceptible to injury by fire.

Monitoring element.—Ratio of species richness of desired tree species 15 years following core establishment as compared to establishment date.

Objective 1.2.5. Develop forest management techniques for FIDS by 2008.

Basis of the objective.—Identifying forest management techniques which not only enhance the quality and health of the forest, but also provide more direct benefits to FIDs and other Neotropical migratory songbirds will compliment and provide additional justification for the objectives and strategies outlined in the step-down forest management plan.

Strategies to achieve the objective.—Implementing forest management practices and careful monitoring will identify management techniques and resulting conditions which are most beneficial to FIDs. By implementing the Resource Inventory and Monitoring Program and closely monitoring Neotropical migrant and FID populations each year, we will better understand their distribution and the main limiting factors for each species. Tying species occurrence to plant community type is essential for assessing species-specific habitat requirements and determining appropriate management needs.

The term "adaptive management" applies to assessing the impacts of all forest management activities to determine any positive or negative impacts to faunal populations with emphasis on FIDs and DFS. Since little information is available that addresses specific forest conditions and management strategies, the efficacy of forest management practices as it relates to FID and DFS populations will be assessed. Conflicts between management techniques will also be evaluated. In order to adequately achieve this objective, a research component, which measures the response of trust resources, should be applied to a variety of forest management practices. We will initiate the following research:

1. The effects of prescribed fire on DFS populations and avian communities in mid-Atlantic coastal plain forested habitats;

2. The effects of selective harvesting techniques on DFS and FIDS; and,

3. The effects of timber stand improvement techniques on DFS and FIDS.

Monitoring element.—The number of research studies implemented.

Subgoal 3. Provide habitats to support a diversity of migrating shorebirds and marsh and water birds.

Objective 1.3.1. Manage a minimum of 200 acres of MSU to provide foraging substrate for shorebirds during the spring migration by 2007.

Basis of the objective.—Blackwater NWR is too far inland to be an important stop-over site for migrating shorebirds. However, as many as 4,000 individuals and 26 species have been recorded in the freshwater impoundments and adjacent estuarine mudflats during peak spring migration. Several of the Calidris "peeps" (primarily semi-palmated and least sandpipers) and the yellowlegs (*Tringa spp.*) migrate through in the spring; dunlin are the most abundant wintering species; and spotted sandpiper, common snipe, and killdeer are the most common breeding shorebirds at Blackwater NWR. The U.S. Shorebird Conservation Plan (2000) and the draft Northern Atlantic Regional Shorebird Plan (2000) rank several of those shorebirds as species of at least moderate concern, due to declining populations at national and regional levels. Both plans recommend more intensive and coordinated manipulation of impoundments on public lands for the benefit of migrating shorebirds. Properly managed, MSU can provide high densities of benthic invertebrates for foraging shorebirds during the spring migration. When spring high tides in the marshes coincide with shorebird migration, the exposed bottoms and relatively shallow water in the MSU can attract large flocks of foraging shorebirds.

Strategies to achieve the objective.—We will expose 15 percent of pool bottoms weekly beginning on April 15 and continuing through May 31 (6 weeks). We will ensure that 50 percent of the bottoms of these pools will be exposed at peak shorebird migration, which generally occurs during the first week in May. Refuge staff will continue ground counts of shorebird populations at weekly intervals during the spring migration and at biweekly intervals during other times of the year. Data will be rolled up into the International Shorebird Survey maintained at the Manomet Center for Conservation Sciences.

Monitoring element.—Percentage of pool bottom exposed.

Objective 1.3.2. Maintain and enhance 15,000 acres of estuarine emergent marsh for nesting, foraging, and resting shorebirds by 2011.

Basis of the objective.—Blackwater NWR has lost nearly 7,000 acres of emergent wetlands since its establishment in 1933. Most of this loss has occurred in the three-square brackish marsh at the confluence of the Little Blackwater and Blackwater Rivers, but is also now progressing up and downstream. The unusually high rate of wetland loss is likely the result of several confounding factors, including sea-level rise, land subsidence, saltwater intrusion, severely modified hydrology, and excessive herbivory. Open water that has displaced the lost wetlands is now used primarily by waterfowl as a disturbance-free rest area during migration and winter, and by resident populations of Canada geese as a safe place to molt during the summer. Its depth precludes use by shorebirds other than phalaropes.

Restoring emergent marsh will enhance the significance of these wetlands to migrating shore, marsh, and water birds. Emergent marsh provides breeding habitat for several species, primarily spotted sandpiper, willet, and common snipe. At low tides, these habitats provide shallow pools and mudflats for a number of migrants, most commonly greater and lesser yellowlegs, semipalmated sandpipers, least sandpipers, white-rumped sandpipers, dunlins, semipalmated plovers, and killdeer.

Strategies to achieve the objective.—Strategies include restoring the marsh to its 1933 coverage level by implementing the current Refuge Complex Fire Management Plan and proposed Habitat Management Plan, minimizing human disturbance of wintering shorebird populations by prohibiting public entry and boating from October 1 through April 1, and evaluating the effect of the current prescribed fire program on nesting shorebirds. It will be necessary to identify large areas of mudflat and shoreline that are exposed at low tide, and to initiate a new boat survey to evaluate the significance of these sites to spring migrants. A study will need to be developed to estimate the breeding densities of shorebirds (and other marsh birds) by floral community type; this could be conducted in conjunction with the ongoing study of prescribed fire effects on marsh flora.

Monitoring element.—Acres of estuarine emergent marsh and tidal mudflats; boat survey of spring migrant populations at selected sites; nesting densities in marsh exposed to different fire regimes.

Objective 1.3.3. Manage pool 3C (22 acres) to provide roosting habitats for marsh and water birds by 2007.

Basis of the objective.—Impoundment systems support several species of marsh and water birds on the refuge. Properly managed, MSU can provide excellent habitats for anurans and fish, important prey items for marsh and water birds. At least 12 anuran species are known to occur in these impoundments during spring and summer. Fish can become a concentrated food source for egrets and herons during spring drawdown.

Strategies to achieve the objective.—We will continue to manage pool 3C for thermal cover and nocturnal roosting.
Monitoring element.—Surveys to determine acreage maintained in thermal cover.

Subgoal 4. Provide habitats to support a diversity of brackish marsh nesting birds, including rails, sparrows, and other species listed in marshbird species.

Objective 1.4.1. Maintain and enhance 15,000 acres of estuarine emergent marsh for nesting marsh birds.

Basis of the objective.—Blackwater NWR occupies the core of one of the largest contiguous areas of tidal marsh in the northeast United States. Only recently has the conservation value of this habitat for breeding birds been recognized. The Partners in Flight (PIF) Bird Conservation Plan for the Mid-Atlantic Coastal Plain (Watts 1999) ranks tidal marshes third (after pine savannah and barrier/bay islands) in regional priority for bird conservation action. Chesapeake Marshlands NWR bears a particularly high responsibility for the stewardship of brackish marshes within USFWS Region 5 due to the relatively high proportion of the region's high marsh habitat within the complex. The refuge complex's 50,000 acres of high marsh constitute one of only four significant areas of high marsh in the Mid-Atlantic coastal plain (Watts 1999).

Tidal brackish marsh and saltmarsh support a distinct community of breeding birds, several of which are endemic to this habitat type (table 4.1). Tidal marsh endemics at Blackwater include two species, saltmarsh sharp-tailed sparrow and seaside sparrow; and three subspecies, clapper rail (*Rallus longirostris crepitans*), eastern willet (*Catoptrophorus semipalmatus semipalmatus*) and coastal plain swamp sparrow (*Melospiza georgiana nigrescens* (Greenberg and Droege 1990). A number of other species have breeding populations in the Mid-Atlantic region largely confined to tidal marshes. Henslow's sparrow and sedge wren breed in the upper edges of tidal marshes in small numbers in the Mid-Atlantic, and, though not specialists of this habitat, require attention due to their priority conservation status nationally.

Several species breeding in tidal marshes at Blackwater are listed by USFWS as national Birds of Conservation Concern (USFWS 2002). Among factors contributing to this conservation status is the lack of information on population number and trends (Shriver et al. 2004). Two of these species, are also on Birdlife International's Red Data List: black rail (Near Threatened) and saltmarsh sharp-tailed sparrow (Vulnerable). Blackwater-Fishing Bay Marshes Important Bird Area derives its "globally important" status from these two species.

Table 4.1. Avian tidal marsh habitat specialists breeding at Chesapeake Marshlands NWR Complex.

Species	***Endemism category (breeding populations)***[b]	***Birds of Conservation Concern (USFWS 2002)***	***Principal marsh zone***
Blue-winged Teal[a]	4		High
Gadwall[a]	4		High
American Black Duck[a]	4		High
Clapper Rail[a]	2		Low
Black Rail[a]	3	x	High
Northern Harrier[a]	4	x	High
Willet[a]	2		High
Marsh Wren[a]	4		High & Low
Swamp Sparrow[a]	2		High
Seaside Sparrow[a]	1	x	Low
Saltmarsh Sharp-tailed Sparrow[a]	1	x	High

[a]Regularly occurring population at Chesapeake Marshlands NWR Complex.
[b] Category: 1 = species endemic to tidal marsh; 2 = subspecies endemic to tidal marsh; 3 = species with majority of populations in North America restricted to tidal marsh; 4 = species with majority of populations in Mid-Atlantic region restricted to tidal marsh (adapted from Greenberg and Maldonado, in press)

The majority of tidal marsh species nest predominantly in the irregularly flooded high marsh zone (table 4.1), probably because of the greater availability of nest sites safe from flooding. Saltmarsh sharp-tailed sparrows prefer areas dominated by saltmeadow hay (*Spartina patens*) and also occupy smooth cordgrass (*S. alterniflora*) near mean high tide level (Greenlaw and Rising 1994, Gjerdrum et al 2005). Black rails prefer saltmeadow hay marsh and are also found in black needlerush (*Juncus roemerianus*)(Watts 1999, Armistead 1999). Coastal plain swamp sparrows occupy the upper edges of the marsh, nesting in shrubs (*Iva fructesens, Baccharis hamifolia*) among saltmeadow hay (Greenberg and Droege 1990).

Two tidal marsh specialists, seaside sparrow and clapper rail, are most common in the regularly flooded low marsh. Both of these species require small areas of exposed mud for foraging (Watts 1999). Seaside sparrows nest mostly in smooth cordgrass, and build nests elevated on grass stems to avoid flooding (Gjerdrum et al 2005).

Management of tidal marshes for breeding marsh birds should focus on tidal marsh specialists with an emphasis on endemic taxa and species of conservation concern. Relative to most terrestrial habitats, little is known about the habitat requirements of tidal marsh birds and most work has been done in New England and the Gulf coast. Much research is needed in the Chesapeake region. However, available research suggests that they require large areas of marsh with natural tidal flow and abundant nest sites that are concealed from predators and safe from flooding.

Birds of tidal marsh show area-sensitivity in the Chesapeake Bay region and in New England. Clapper rail and seaside sparrow attain 100% incidence in marshes over 5 ha in size, and saltmarsh sharp-tailed sparrow, black rail,

Henslow's sparrow and sedge wren may require marshes of at least 100 ha (Watts 1999). In New England, willet, clapper rail, seaside sparrow, saltmarsh sharp-tailed sparrow and Nelson's sharp-tailed sparrow had a higher incidence on larger marshes in at least one of two regions studied (Shriver et al 2004).

Among the features contributing to Blackwater NWR's great value to tidal marsh nesting birds is the large area of marsh having relatively natural hydrology. In a review of impacts of marsh management on coastal marsh bird habitats Mitchell et al (in press) found that structural marsh management such as impoundments generally benefit wintering waterfowl and other waterbirds but are avoided by tidal marsh endemics. In New Jersey, clapper rails, seaside sparrows and saltmarsh sharp-tailed sparrows were found only in unimpounded marshes (Burger et al 1998).

Birds nesting in the high marsh zone require areas of dense vegetation for nest placement and thus management practices that allow a thatch of grass litter to accumulate across years will benefit tidal marsh species. Saltmarsh sharp-tailed sparrows select nest sites where grass vegetation is taller and more dense than random locations, with a denser layer of thatch from previous years (Greenlaw and Rising 1994, Gjerdrum et al. 2005). Although flooding is the greatest cause of nest failure in this species (Greenlaw and Rising 1994, Gjerdrum 2005), dense vegetation presumably plays an important role in concealing nests from predators. Nest placement in tidal marsh nesting sparrows may be a trade-off between avoiding flooding (by placing nests higher in grass vegetation) and avoiding predation (by placing nests in lower, concealed sites). In a review of nesting ecology of tidal marsh sparrows in North America Greenberg et al. (in press) found that nest mortality caused by flooding and predation are largely compensatory.

Strategies to achieve the objective. – Strategies include restoring the marsh to its 1933 coverage level, conducting research to investigate habitat and nest-site selection of marsh birds, and evaluating the effect of current prescribed fire program on nesting marsh birds. An extensive survey, employing recently adopted national marshbird monitoring protocols, and also specially adapted survey protocols for saltmarsh sharp-tailed sparrows (recently developed in New England), would be needed to investigate habitat relationships of marsh birds. The recent study of burning impacts on marsh-nesting sparrows would be continued and expanded to include other marsh birds. These would be conducted in conjunction with the ongoing study of prescribed fire effects.

Monitoring element. – Acres of estuarine emergent marsh, research results relating marsh bird densities to vegetation type, research results relating nesting densities and nest success to different fire regimes.

Subgoal 5. Provide habitats to support a diversity of raptors.

Objective 1.5.1. Provide habitat for forest interior dwelling raptors by 2007.

Basis of the objective.—Red-shouldered hawks (*Buteo lineatus*), broad-winged hawks (*Buteo platypterus*), and barred owls (*Strix varia*) are raptors that require large forest tracts (>250 acres) and are known to breed on the Maryland coastal plain (Robbins and Blom 1996). The draft "Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area" considers these raptors to be highly area-sensitive species. The Partners in Flight draft "Mid-Atlantic Coastal Plain Bird Conservation Plan" specifically recommends that populations of these species and of Cooper's hawks be monitored. The forests that the refuge maintains are some of the most extensive and contiguous that remain on the Maryland coastal plain.

Strategies to achieve the objective.—We will maintain and enhance large stands of contiguous mature forest by implementing the draft Forest Management Plan; continue strategic land acquisition to reduce the patchiness of existing forest and increase total forest acreage; continue the annual breeding forest bird survey; and, consider designing a tape play-back survey for nocturnal raptors, especially barred owls.

Monitoring element.—The number of forested tracts >250 acres.

Objective 1.5.2. Provide marsh habitat for raptors by 2007.

Basis of the objective.—Blackwater NWR provides almost 7,000 acres of estuarine emergent marsh. Ospreys, northern harriers, and peregrine falcons are dependent on this habitat for at least part of their life needs, and all are considered priority species in the Partners in Flight draft "Mid-Atlantic Coastal Plain Bird Conservation Plan" (1999).

Strategies to achieve the objective.—Strategies include minimizing disturbance in the marsh by prohibiting public entry and boating from October 1 through March 31, implementing restoration tasks in the proposed Marsh Management Plan, and continuing strategic land acquisition to mitigate for marsh loss.

Monitoring element.—Acreage of marsh.

Objective 1.5.3. Provide artificial nest structures and evaluate their importance by 2007.

Basis of the objective.—Blackwater NWR has provided artificial nesting structures for a number of bird species of concern, including 10 nest boxes for barn owls (*Tyto alba*) and 30 nest platforms for 30 ospreys. Now that populations of these species recently have recovered, the need for continuing this program is questionable. These artificial structures require annual maintenance, periodic monitoring, and control of exotic species (house sparrows, European starlings) that displace targeted native species.

However, the deployment of artificial nests or nest substrates still may prove beneficial to some species. The hacking towers on Smith, South Marsh, and Spring Islands have fledged many peregrine falcons since their construction. Similarly, artificial nest platforms may increase the productivity of American black ducks nesting in the frequently inundated black needlerush marsh on Martin NWR (M. Haramis, USGS, pers. comm.). Artificial nesting structures also have value as a medium for public education.

Strategies to achieve the objective.—The reproductive contribution of the existing osprey platforms to local and regional populations needs to be evaluated. We will need to contrast the annual estimates of platform occupancy and subsequent production with state and regional estimates of osprey populations. We will maintain the existing osprey platforms on the refuge until we have completed that evaluation. Also, a study to evaluate the efficacy of using artificial structures to enhance black duck nesting on the Refuge Complex will be developed under the proposed American Black Duck Initiative.

Monitoring element.—Occupancy rates; fledgling rates; wood duck fall brood survey; completion of the American Black Duck Initiative.

Subgoal 6. Accomplish applicable recovery plan objectives and other management activities for Federal-listed species.

Objective 1.6.1. Accomplish all recovery tasks that are delegated to the refuge for DFS by 2017.

Basis of the objective.—The main thrust of the recovery program for DFS is protecting occupied habitats and re-establishing populations in previously occupied areas. Comprehensive DFS population or habitat surveys on Blackwater NWR have been limited to two benchmark sites. The refuge has significantly more forest habitat that is known to be occupied by DFS.

Strategies to achieve the objective.—The first strategy will be to complete a more detailed assessment of potential DFS habitats and conduct, at a minimum, presence or absence surveys to ascertain the percentage of occupied versus potentially occupied habitats. Preferably, more extensive 'mark recapture' studies will be conducted in all forested habitats, in order to determine current population status and possible trends. We will accomplish this as part of the Complex-wide Resource Inventory and Monitoring Program.

We will also evaluate these recovery tasks.

1. Describe habitat use and requirements of populations within their current natural ranges;

2. Develop an integrated habitat protection strategy using remote-sensing procedures and geographic information systems;

3. Define and field test applications for the Habitat Suitability Index model; map available habitat;

4. Protect DFS and its habitats;

5. Monitor current and potential threats to the DFS or its habitat;

6. Devise and implement a habitat management scheme;
7. Determine the effects of timber management and other land use practices on DFS;

8. Develop and refine prescriptive habitat management for DFS;

9. Develop and implement guidelines for habitat management on public lands occupied by DFS; and

10. Monitor the outcome of prescriptive habitat management.

Objective 1.6.2. Establish, manage, and enhance seven mature forest cores of 400 acres or more for DFS by 2017.

Basis of the objective.—The primary basis is to significantly improve the likelihood of down-listing or delisting the species. For the reclassification of the DFS from endangered to threatened, ecological requirements and distribution within the natural range must be fully understood, the seven benchmark populations must be stable or expanding for at least 5 years, and 10 new colonies must be established within the historical range.

The DFS will be considered for delisting when, besides having met the reclassification criteria, the following elements have been achieved.

1. Five post-1990 colonies are established outside the remaining natural range.

2. Periodic monitoring shows that 80 percent of translocated populations have persisted over the full period of recovery, and at least 75 percent of these populations are not declining.

3. Mechanisms that ensure perpetuation of suitable habitat at a level sufficient to allow desired distribution are in place within all counties in which the species occurs.

4. Mechanisms are in place to ensure protection and monitoring of new populations, to allow for expansion, and to provide interpopulation corridors to permit gene flow among populations (USFWS 1993).

By protecting occupied and potentially occupied habitat within the DFS historical range and providing additional distribution data, the refuge will significantly contribute to this effort. Although beliefs vary on the preferred forest cover types, age, and tree species composition, it is widely agreed that DFS appear to persist in larger densities in "mature" forests with a sparse understory. In combination with objective 1.5.3, below, the refuge's forested lands should accelerate de-listing by assuring the long-term availability of habitats needed to maintain natural populations and to assure the long-term continuance of a stable or expanding population throughout a significant portion of the DFS historic range.

Strategies to achieve the objective.—One main thrust of the recovery program for DFS is to protect occupied habitats. Blackwater NWR continues to maintain or enhance habitats that support the largest naturally occurring remnant populations of DFS. Strategies include acquiring land; remote sensing to identify areas of mature forest; establishing mature forest cores, as in Goal 1, Subgoal 2, Objective 1; reforesting PC wetlands and recently cleared timber lands; implementing silvicultural prescriptions; and, integrated pest management. Since the habitat requirements for FIDs are much more restrictive than those of DFS, we are assuming that any land protection or management strategies to enhance FID populations will also, directly or indirectly, benefit DFS.

Monitoring element.—The number of 400-acre mature forest cores established by 2017.

Objective 1.6.3. For DFS, maintain an average stand diameter of 15 inches (38.1 cm) DBH, or greater, of upper canopy trees within all core areas, as well as on an additional 10 percent of the remaining forested habitat, by 2022.

Basis of the objective.—Forest stands characterized by an average tree diameter of 15 inches, or greater, will exceed the currently accepted theory articulated in the recovery plan (USFWS 1993) and more recent activities by the DFS Recovery Team, on what constitutes "optimal habitat." Forest stands with an average overstory tree diameter of 15 inches (38.1 cm), or more, will provide adequate cover and reproductive habitats. The optimum tree canopy closure for DFS is from 20 to 60 percent. Optimal understory closure occurs when the shrub-crown closure is 30 percent or less (Allen 1982, and Tesky 1993). Habitat Suitability Index models indicate that sites where DFS were present contained a higher percentage of large [12-inch (>30-cm) DBH] trees (DFS Recovery Plan 1993).

Strategies to achieve the objective.—Acquiring tracts of forest land adjacent to existing cores or large enough to become cores will be instrumental in achieving this objective. As additional lands containing large trees are added to cores, portions of the cores which are exhibiting signs of declining health and vigor may be harvested to make room for new vigorous trees, while still maintaining an average DBH of 15 inches (38.1 cm) for upper canopy trees. All harvest and regeneration methods, excluding clearcutting, may be implemented within the core areas at any time, as long as those methods do not result in the creation of gaps in the forest canopy greater than 30 feet (10 m) (Draft Guidance: a Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area, Oct 1999). If removing forest products results in gaps greater than 30 feet (10 m), the acreage on which the harvest occurred will be excised from the core until the canopy had sufficiently closed.

Within established core areas, applying silvicultural prescriptions will be required in order to achieve this objective. These prescriptions will primarily consist of the various types of timber stand improvement techniques and several harvest methods. Timber stand improvements will focus on improving growing conditions for the preferred tree species assemblage (specifically, nut and seed-producing species, such as oaks and pines).

Timber stand improvements include, but are not limited to, release cuttings, mechanical thinning, chemical thinning, crown thinning, low thinning, and improvement cuts. The various harvest methods employed will focus on regenerating the stand while at the same time retaining a significant percentage of large healthy hard and soft mast-producing trees. Growth rates of the remaining trees will ultimately be enhanced by the reduction in stand density and competition. The various harvesting methods to be employed within the cores may consist of single tree and group selection, shelterwood, and strip and patch clearcuts.

Protection of these core areas from insect pests and diseases will be essential for achieving this objective. Poor and declining health is the cause of most insect and disease outbreaks, and can result in large-scale tree mortality, cover-type conversions, invasions of exotic species, or loss of habitats. Continued coordination with USFS will be required to monitor and manage forest pest populations, specifically, gypsy moths. We will implement integrated pest management strategies as needed.

Monitoring element.—Average DBH of upper canopy trees for each core in 2022.

Objective 1.6.4. For DFS, improve the quality of an additional 1,500 acres of forested habitats outside the core areas by 2017.

Basis of the objective.—An additional 1,500 acres of existing forested habitats, which do not meet the minimum requirements to be included in a core due to juxtaposition or age structure, will be managed more exclusively for DFS and forest health. Management of these areas for FIDs will not be pursued until they become or are included within core lands. Most of these lands are in need of forest management to improve overall forest health, species diversity, age class diversity, and mast production. Proper management will also reduce the susceptibility of these habitats to insect and disease outbreaks.

Strategies to achieve the objective.—Where applicable, an extensive list of silvicultural techniques will be utilized to improve the health and quality of these forested habitats. In order to most effectively improve the health and quality

of forest habitats, management strategies will consist of performing a wide array of timber stand improvements, regeneration techniques, or harvest methods. Timber stand improvements will consist of all previously described release cuttings, thinning, and also, prescribed fire.

Timber harvesting methods may include clearcutting, seed tree harvests, single tree and group selection, strip and patch clear-cut, shelterwood cuts, salvage cuts, sanitation cuts, and other forest management practices that focus on improving site conditions for natural regeneration or establishing planted trees. These methods may include various types of regeneration harvests, site preparation and the control of undesirable vegetation through the use of prescribed fire, as well as mechanical and chemical methods. Integrated pest management strategies will be employed to monitor and control forest pest populations.

Monitoring element.—The overall health of the forest as it relates to tree growth and wildlife benefits. Some post-management variables which may be measured include growth rates and mast production of preferred tree species, understory density, regeneration and presence or absence of disease or insect pest populations.

Objective 1.6.5. Establish an additional 2 miles of 50-foot-wide forest corridors to connect disjunct forested patches by 2017.

Basis of the objective.—Forested corridors are necessary to aid DFS in traveling from one forest patch to another, and provide safe access to additional breeding and feeding habitat. This connectivity will reduce forest fragmentation and its associated detriments to wildlife populations on the refuge.

Strategies to achieve the objective.—Reforestation of PC wetlands will be the initial strategy implemented to create forest corridors between disjunct forest patches. We will assess all our currently owned and newly acquired PC wetlands to determine their suitability for establishing additional corridors. Reforestation of cut-over areas and abandoned or unnecessary roadbeds will also be targeted. We will continue to strategically acquire land, focusing primarily on land that contributes to combating the fragmentation of refuge forested habitats.

Monitoring element.—Miles of additional forest corridors, as compared to the present.

Objective 1.6.6. Maintain the 1996–2003 average of nesting and wintering bald eagles on Blackwater NWR by 2007.

Basis of the objective.—The Chesapeake Bay population of American bald eagles is Federal-listed as threatened. As the most significant nesting area north of Florida on the Atlantic Coast, Blackwater NWR has played a major role in recovering this species. Nesting pairs on the refuge have increased from 3 in 1978 to as many as 14 in 1997, and almost 300 eaglets have been produced in the past 15 years. Nests on Blackwater NWR have been the source for several translocation efforts in New Jersey and elsewhere. Also, Midwinter Bald Eagle Surveys during the past 5 years indicate that at least 150 bald eagles now winter on Blackwater NWR.

Strategies to achieve the objective.—Winter roost sites and nest sites will continue to be monitored and protected from human disturbance following the guidelines in the recovery plan (USFWS 1990) and "Bald Eagles in the Chesapeake: A Management Guide for Landowners" (National Wildlife Federation 1985). We will maintain an inviolate sanctuary encompassing 11,270 acres of water and marsh, by prohibiting public entry and boating from October 1 through April 1. Refuge biological staff will continue to support two annual surveys sponsored by the Maryland DNR: the Midwinter Bald Eagle Survey in January; and aerial nest surveys December–March. Staff will continue to conduct periodic roost counts, and investigate the status of suspected new roost sites. Blackwater NWR will also continue to be a translocation source for other states as needed. Management recommendations in the delisting package will be implemented as applicable.

Monitoring element.—The numbers of nesting and wintering bald eagles as determined by aerial surveys and the Midwinter Bald Eagle Survey.

Objective 1.6.7. Determine the occurrence of the Federal-listed swamp pink, sandplain gerardia, and sensitive joint-vetch on Blackwater NWR by 2008.

Basis of the objective.—Swamp pink (*Helonias bullata L.*; G3/S2), Federal-listed as threatened in 1988, is an obligate wetland perennial that occurs along streams and seepage areas in freshwater swamps and other wetland habitats. Swamp pink is known to exist in areas of Dorchester and Wicomico Counties and, possibly, may exist on Blackwater NWR.

The sensitive joint-vetch (*Aeschynomene virginica*; G2/S1) is an annual legume that occurs in fresh to slightly brackish tidal river systems. We need to discover whether sensitive joint-vetch occurs on Blackwater NWR. It was Federal-listed as threatened in 1992, due to its limited distribution. On the Eastern Shore, extant populations of *A. virginica* occur on Manokin Creek in Somerset County, and historic populations (before 1910) have occurred on the Nanticoke River in Wicomico County. Where *A. virginica* has been found in Maryland, it has been associated with *Echinochloa sp.*, *Spartina cynosuroides*, *Polygonum sp.*, *Juncus sp.*, and *Hibiscus moscheutus*, although the substrates have been sparsely vegetated; "e.g., muskrat "eat-outs" (USFWS 1995). These habitat conditions certainly exist on riparian areas of Blackwater NWR.

The sandplain gerardia (*Agalinis acuta*) was listed as endangered in 1991. In Maryland, one population on protected state lands occurs on the western shore. The Nature Conservancy identifies this species as potentially occurring in the focus areas (Nanticoke River Bioreserve Strategic Plan, 1998), but no comprehensive surveys for this species have been conducted.

Strategies to achieve the objective.—As part of the Complex-wide Resource Inventory and Monitoring Program, we will aggressively search for Federal- and State-listed flora, particularly swamp pink and sensitive joint-vetch, within the boundaries of Blackwater NWR. We will contract experts from the State Heritage Program or from universities to conduct botanical surveys. The conservation and management of any listed species that are identified will follow applicable tasks identified in USFWS recovery plans (USFWS 1991, 1995), and will be closely coordinated with the State Heritage Program.

Monitoring element.—Completion of the baseline inventory or botanical surveys.

Subgoal 7. Restore, protect and enhance habitats for anadromous and interjurisdictional fish species.

Objective 1.7.1. Inventory anadromous and estuarine or inland interjurisdictional fisheries on the Blackwater River and tributaries by 2008.

Basis of the objective.—The Blackwater River watershed historically provided nursery and spawning habitat for striped bass (*Morone saxatilis*), white perch (*Morone americana*), river herring (*Alosa pseudoharengus*, *A. aestivalis*), American eel (*Anguilla rostrata*), hickory shad (*Alosa mediocris*), American shad (*Alosa sapidissima*), and gizzard shad (*Corosoma cepedianum*). Other species of concern likely to occur in the Blackwater River watershed include mud sunfish (*Acantharchus pomotis*; G5/S2) and black-banded sunfish (*Enneacanthus chaetodon*; G4/S1). Turbid waters, due to marsh loss and frequent saltwater intrusion in recent years, have greatly reduced the quality of aquatic habitats. A fishery resource inventory is required to determine current status and abundance of species.

Strategies to achieve the objective.—We will conduct an initial survey to determine the occurrence and relative abundance of these species in the Little Blackwater and Blackwater Rivers. This survey will be conducted in cooperation with USFWS Fisheries Resource Office and other partners. The focus will be anadromous species, coastal migratory fishes identified in the Atlantic Coastal Fisheries Cooperative Management Act of 1993, and those species for which the Fisheries Management Workgroup of the Chesapeake Bay Program has developed fishery conservation plans. Based on the outcome of this inventory, monitoring of selected populations may be warranted.

Monitoring element.—Completion of survey.

Objective 1.7.2. Restore natural hydrology of the Upper Blackwater to pre-1980 conditions by 2007.

Basis of the objective.—The Blackwater River historically was more typical of tidal rivers on the Eastern Shore, with cattail (*Typha sp.*) marshes in the upper watershed changing to *Spartina alterniflora*-dominated saltmarsh at the mouth. Salinity levels varied from 0 ppt at the headwaters to 20 ppt near the mouth at Fishing Bay. However, in recent years, salinity in the upper reaches of the Blackwater River has exceeded 20 ppt, due to saltwater intrusion from Stewart's Canal. Loggers built this canal in the 1840s to allow barge access from Slaughter Creek to forests on Parson's Creek Neck and Piney Swamp. In the past two decades, salt water has more frequently breached the marsh that separates Stewart's Canal and Goose Dam from Moneystump Swamp at the headwaters of the Blackwater River. Increasing salinity and subsequent wetland loss have severely degraded freshwater fisheries and the value of the Blackwater River as spawning habitat for anadromous species.

Strategies to achieve the objective.—A marsh management plan will be developed to restore the freshwater system to the upper reaches of the Blackwater River. Strategies will include using clean dredged material to restore marsh between Blackwater River and Parsons Creek, the construction of a flap gate on the Slaughter Creek drainage, continued control of nutria, and other tasks identified in subgoal 1, objective 2. We may consider restocking the freshwater and anadromous fisheries, pending the outcome of post-restoration fisheries surveys. Similarly, it may be necessary to replant or reseed freshwater wetland plants after natural hydrology has been restored.

Monitoring element.—Survey fisheries (see objective 1) and salinity or water quality (see objective 3) before and after restoration.

Objective 1.7.3. Establish a long-term program to monitor salinity and other water quality parameters at selected sites in the Blackwater and Little Blackwater Rivers by 2007.

Basis of the objective.—Since 1996, the refuge routinely has monitored salinity and other parameters to document the water quality degradation that may be contributing to marsh loss on Blackwater NWR. The current protocol involves discrete sampling of salinity, temperature, pH, dissolved oxygen, and hydrogen sulfide at ten sites on the Blackwater and Little Blackwater Rivers every 2 weeks. However, because many factors such as tidal variation and storm events confound the interpretation of these data, this monitoring regime poorly describes long-term trends and fails to accurately quantify the magnitude and extent of saltwater intrusion.

Also, it is critical that the refuge have a reasonable data base from which to assess the effects of implementing restoration tasks identified for marsh management. A more rigorous monitoring program is needed that will not only provide more meaningful background levels of water quality parameters, but also allow continuous sampling to capture extreme saltwater intrusion events.

Strategies to achieve the objective.—Real-time monitoring equipment, capable of sampling diel variation in salinity and other water quality parameters (salinity, temperature, pH, DO, H_2S, conductivity, light penetration and turbidity), will be deployed at four permanent water quality sites: on Blackwater River below Stewart's Canal or Goose Dam; at the confluence of the Little Blackwater and Blackwater Rivers; at the mouth of the Blackwater River near Fishing Bay; and on the Little Blackwater River adjacent to the boathouse. Monitoring of these sites will provide adequate background data from which to assess changes in salinity (and other parameters) after implementing restoration tasks identified in the Marsh Management Plan. Additionally, a permanent tide gauge on the Little Blackwater River adjacent to the Blackwater Field Station will be established.

Monitoring element.—The number of monitoring stations established.

Objective 1.7.4. By 2011, initiate water and sediment quality and contaminant assessments on the Nanticoke River and its tributaries.

Basis of the objective.— According to the Maryland Department of Natural Resources, nitrogen levels in the Nanticoke River are among the worst of all tidal tributaries in Maryland. A recent report by the State of Delaware adds that the most significant water quality problems in the Nanticoke River include bacterial contamination and eutrophic conditions (e.g., nutrient over-enrichment). The possible sources of this nitrogen are many: both natural and human-generated. Septic systems, agricultural crops, lightning, livestock or poultry operations, and decaying

plant materials have all been documented as releasing or contributing factors to eutrophication. The future health of the Nanticoke watershed and its wildlife is largely related to the amount of nutrients entering the ground and surface water.

Strategies to achieve the objective.—We will establish a series of permanent real-time water quality stations throughout the division. We will periodically monitor benthos, physical, and chemical parameters at fixed stations in the river and its tributaries. We will collect data to document and assess nutrient loading and other potential adverse impacts from land use changes and practices. To the extent possible, we will use water quality data and monitoring results from other agencies. If warranted, we will collect samples for pesticide or herbicide analyses, and periodically monitor selected sites for trace element concentrations in water sediment or biological tissues.

The Service will collect additional data on bacteria contamination. If nutrients continue to be of concern, we will pursue source identification and work with appropriate entities to identify measures to reduce concerns with nutrient or bacteria transport into or through division habitats. The Service will monitor contaminant concentrations in sediment and biological tissues to evaluate contaminant risk in wetland and aquatic systems and associated fish, wildlife and plants. Measures to reduce or manage risks will be developed if warranted.
Refuge staff will cooperate to the extent possible in the broader Chesapeake Bay Program initiatives addressing water quality issues, including participation in the Lower Shore Tributary Strategy Team. Equipment will be acquired and partnerships will be established with other agencies to more effectively assess water quality impacts to species and their habitats.

Monitoring element.—Establishment of water quality stations, water quality monitoring protocols, and development of hydrological models, if appropriate; extent of mapping and assessments of hydrological modifications; analysis of solids, ions, nutrients, trace elements, and bacteria.

Objective 1.7.5. Implement recommendations of Little Blackwater River contaminants monitoring study by 2010.

Basis of the objective.—Animal feed operations (AFOs), particularly poultry farms, and the application of their wastes as fertilizer are known to contribute excessive nutrients, trace metals, and estrogenic compounds to surface and ground waters of the Blackwater watershed. Although fewer than a dozen commercial poultry operations and only one large hog farm exist within the Little Blackwater River, Buttons Creek, and Transquaking River watersheds, the amount of manure produced from these livestock is staggering: 1,000 chickens produce one ton of manure. Excessive nutrient loading from leachate and runoff from fields on which the manure is applied can contribute significantly to algal blooms, decreased water clarity, anoxia, and reduced SAV.

Eutrophication from AFO activities has also been linked to outbreaks of *Pfiesteria piscicida*, a dinoflagellate that has caused fish kills on the nearby Chicomicomico River. Our Chesapeake Bay Field Office is now studying the contribution of commercial poultry and swine operations to phosphate, nitrate, trace metal, and estrogenic compound levels in the Little Blackwater River. Their final report will address the need for long-term contaminants monitoring and specific management recommendations.

Strategies to achieve the objective.—We will need to pursue implementing the recommendations at the conclusion of this study.

Monitoring element.—Contingent on study recommendations.

Goal 2. Maintain a healthy and diverse ecosystem with a full range of natural processes, natural community types, and the full spectrum of native plants and animals to pass on to future generations of Americans.

Subgoal 1. Control, eradicate, or manage injurious, invasive, and exotic species

Objective 2.1.1. Eradicate nutria populations on Blackwater NWR by 2017.

Basis of the objective.—Executive Order No.13112 (Feb. 1999) directs all Federal agencies to prevent and control introductions of invasive species in a cost-effective and environmentally sound manner. Blackwater NWR has lost more than 7,000 acres of estuarine marshes since the 1940s. Several factors compound that loss, including sea-level rise, land subsidence, saltwater intrusion, modified hydrology, and excessive herbivory by the introduced nutria (*Myocastor coypus*).

Nutria, indigenous to southern South America, were introduced in Maryland in 1943. High population densities (over 50,000), high reproductive rates, and unique behavioral attributes make herbivory by this rodent species problematic. A 3-year study (Mike Haramis, USGS–BRD Patuxent Wildlife Research Center) of 342 fixed vegetative plots within 57 quarter-acre experimental units clearly demonstrates that nutria "eat-outs" into the root mat are degrading the marsh's ability to maintain itself.

Strategies to achieve the objective.—In January 2003, we implemented the National Strategy and Standard Operating Procedures for Managing Invasive Species as contained in part 1, dated August 31, 2001. In 1997, 23 organizations formed the Nutria Partnership to deal with this problem. Partners include Blackwater NWR, Chesapeake Bay Field Office (USFWS), Patuxent Wildlife Research Center (USGS–BRD), MD Cooperative Fish and Wildlife Research Unit (USGS–BRD), MD Department of Natural Resources, MD Department of the Environment, UM–ES, UM–College Park, Tudor Farms, Ducks Unlimited, National Fish and Wildlife Foundation, Friends of Blackwater, the American Aquarium and Zoological Association, the MD Fur Trappers Association, the MD and DE Chapter of the Wildlife Society, and the Salisbury Zoo.

In FY 2000, the partnership implemented the "Marsh Restoration: Nutria Control Plan" in Maryland. That was a 3-year pilot project to develop control techniques, study population demographic and reproductive response, and develop marsh restoration techniques. The eradication program began in 2002, and will continue until eradication has been achieved. We will also continue the nutria trapper rebate program at Blackwater NWR; this program has removed almost 58,000 nutria from the refuge in the past 15 years.

Monitoring element.—Surveys to determine the success of the eradication program.

Objective 2.1.2. Reduce the resident Canada goose population to its 1989 level by 2008.

Basis of the objective.—The resident Canada goose population on Blackwater NWR increased from an estimated 350 in 1989 to more than 5,000 in 2000. During that same interval, the resident Canada goose population in Maryland increased from 25,000 to 90,000. The direct and indirect results of this population explosion are adversely affecting the primary purpose for which the refuge was established.

Exclosures constructed by refuge staff in the spring of 1999 clearly demonstrated that resident geese were seriously impacting the natural marsh vegetation at Blackwater NWR. Studies conducted by Haramis and Kearns in the Patuxent Marshes, Maryland; May and Kangas in Kenilworth Marsh, Washington, D.C., and Nichols on the Maurice River, New Jersey substantiated similar destruction of natural marsh vegetation by resident Canada geese. A study at Bombay Hook NWR also demonstrated that resident geese are significantly affecting natural vegetation in moist soil impoundments. These findings are consistent with observations at Blackwater NWR, which not only suggest that resident geese are impacting moist soil vegetation, but that they are causing significant damage to natural marshes and agricultural crops planted to provide forage for migrating and wintering waterfowl. Increasing damage has been documented by refuge staff during the past 10 years throughout the refuge.

Also, resident Canada geese concentrate around the remaining water in impoundments during summer drawdowns. The resulting concentrations of fecal droppings in these stagnant pools, when the temperatures are high, create excellent mediums for degraded water quality, and increase the potential for fecal-borne human and avian diseases. The National Wildlife Health Research Center (NWHRC) found that 16 percent of 37 resident geese sampled in 1998 and 32 percent of 90 resident geese sampled in 2000 from Blackwater NWR were DVE-positive (duck virus enteritis, or duck plague). There is also increased concern regarding the transmission of diseases, such as cryptosporidiosis, giardiasis, chlamydiosis, and West Nile virus. Because of these potential problems, Region 5 funded investigations by NWHRC and the New Jersey Division of Fish, Game, and Wildlife in 1999 to evaluate threats to human health posed by resident Canada geese in Rhode Island, New Jersey, and Virginia.

Strategies to achieve the objective.—The primary strategy will be to implement the approved Integrated Wildlife Damage Management Plan for reducing current refuge population levels and mitigating the impacts of resident geese. (Contact headquarters for a copy of the EA.) That plan includes using nonlethal scare techniques, such as pyrotechnics, propane cannons, eagle effigies, reflective tape, balloons, and flags; and using perimeter fencing to exclude geese from certain areas. Lethal components of the plan include nest and egg destruction, live capture with humane euthanasia by certified processors, and selectively killing individuals to reinforce nonlethal methods.

Another possible strategy is a late spring hunt after migrant populations have moved through the area. Conservation measures similar to those for late season snow goose hunting will have to be authorized by the USFWS and the Atlantic Flyway Council before spring hunting is allowed. The Migratory Bird Treaty Act does not permit hunting Canada geese after 15 March.

Monitoring element.—Summer ground surveys for waterfowl.

Objective 2.1.3. Eradicate the mute swan population on Blackwater NWR by 2012.

Basis of the objective.—Mute swans (*Cygnus olor*) are exotic birds that escaped into the Chesapeake Bay in 1962, and now number approximately 4,000. Mute swans destroy SAV beds and disrupt nesting colonial waterbirds. The island refuges harbor most of the mute swans on the Refuge Complex, but Blackwater NWR also sustains a few pairs. Maryland DNR began controlling mute swan populations in 1993, and requested refuge assistance in 1995.

The State initially authorized Blackwater NWR to take both eggs and swans. However, due to legal action and public outcry, all permits have been canceled. The Service and the State are developing legislation to allow swan control. Most waterfowl and wetland biologists in the Chesapeake Bay region advocate a return to a more aggressive method for controlling mute swan populations. This is consistent with a directive by the USFWS Directorate to all Regional Directors to support the recommendations of the Atlantic Flyway Council regarding mute swans (see below).

Strategies to achieve the objective.—In 2001, Blackwater NWR staff participated on an interagency Mute Swan Task Force to develop a management policy for the State of Maryland. The Service will continue to work with the State and USDA to develop legislation and permitting authority to authorize (sic) the refuge to take both eggs and swans to achieve the eradication goal. The refuge may or may not comply with recommendations made by the task force. Also, the refuge may or may not comply with the recommendations of the Atlantic Flyway Council, which endorses the following actions.

1. State wildlife agencies, if they do not already have the authority, should seek to gain authority over the sale and possession of mute swans and their eggs.

2. The sale of mute swan adults, young or their eggs should be prohibited.

3. States should seek to eliminate all importing and exporting of mute swans without a special purpose permit issued by the state wildlife agency.

4. Mute swans captured due to nuisance complaints, sickness, or injury should be removed from the wild or be euthanized.

5. Egg addling programs where feasible should be encouraged.

6. Both state and Federal wildlife agencies should institute programs to prevent the establishment of, or eliminate, mute swans.

7. States should seek to make the mute swan an unprotected species if this is not already the case.

8. States should strive to manage mute swan populations at levels that will have minimal impacts on native wildlife species or habitats.

Monitoring element.—Survey in summer to determine the success of the eradication program.

Objective 2.1.4. Control gypsy moth populations on Blackwater NWR by 2008.

Basis of the objective.—Control of gypsy moth populations is required to protect mixed hardwood and hardwood forests, which are essential for supporting endangered DFS, FIDS, and other wildlife. Epidemic gypsy moth populations have plagued Blackwater NWR since 1993, primarily due to the large number of host tree species, the lack of forest management, and declining forest health conditions. Acquiring lands that are already infested with gypsy moths or other forest pests adds to the problem. Many times, lands that are added to the refuge need immediate treatment to prevent the total loss of wildlife habitat. We may need to implement more detailed property assessments, in order to detect insect and disease infestations. Any such findings should reduce the price we pay for those lands.

Strategies to achieve the objective.—Since 1993, Blackwater NWR has participated in, and benefitted from, the USFS Forest Pest Management Program. This program alone is responsible for protecting thousands of acres of prime DFS habitat. Although the program provides funding and expertise to assist the refuge in controlling our gypsy moths, it may someday disappear. In that event, we will become responsible for providing funding to ensure the protection of these vital habitats from the many potential insect and disease outbreaks. The refuge will continue to coordinate with the USFS to monitor gypsy moth populations and provide recommendations for control. At a minimum, USFS will continue to conduct annual gypsy moth egg mass surveys to determine population densities, recommend control treatments, assist with the acquisition of forest pest management funding, conduct post treatment aerial defoliation surveys and prepare annual reports.

Refuge personnel will continue to provide USFS personnel with up-to-date GIS data to inform them of new land acquisitions and the location of additional forest lands to be surveyed. Refuge forestry personnel will assist with annual egg mass surveys, the preparation of funding proposals and pesticide use proposals, and the administration of control treatments. A method for controlling gypsy moth populations will continue to be aerial application of Bt (*Bacillus thuringiensis*) or Gypcheck, which are both viable biological insecticides. The susceptibility of forested habitats to gypsy moth and other forest pest infestations will be minimized by improving the overall health of forests on the refuge as outlined in previous objectives.

Monitoring element.—Gypsy moth population status as determined by USFS annual surveys and monitoring. Intensified monitoring to assess the effects of management on stands' susceptibility to gypsy moth infestations, and to assess the threats to non-target species.

Objective 2.1.5. Eradicate Phragmites in the MSU, and reduce Phragmites below 2000 levels elsewhere.

Basis of the objective.—Over the past several decades, populations of common reed (*Phragmites australis*) along the Atlantic Coast have dramatically increased in both freshwater and brackish wetlands. At present, convincing and decisive evidence for the status of *P. australis* as native, introduced, or both, is not available (Blossey and McCauley 2000). Phragmites seeds profusely, and spreads vegetatively, by a vigorous system of rhizomes and stolons. Its monotypic stands have replaced diverse wetland plant communities with, and have changed basic ecosystem processes.

Dense Phragmites stands decrease native biodiversity and impact the quality of wetland habitat, particularly for waterfowl. Phragmites, however, may serve to abate wave-induced shoreline erosion. Refuge staff have conducted

limited (<60 acres annually) aerial- and hand-spraying with the aquatic formulation of glyphosate along the edges of impoundments and the forest–marsh ecotone, but funding in the past has been inadequate to control Phragmites over more extensive reaches of the marsh.

Strategies to achieve the objective.—Phragmites control measures will include the use of herbicides, mowing, discing, dredging, and burning. Biological control agents specific for Phragmites are being investigated at Cornell University, and will be used if feasible. The most widespread and successful approach on refuges is the application of glyphosate late in the growing season, followed by prescribed burning or mechanical removal of dead stalks. One reason for the reliance of chemical control is that habitat management methods such as burning, cutting, mowing, and discing actually encourage the spread of Phragmites.

Holding water within managed impoundments for sufficient durations to kill Phragmites is not a viable option because these systems require annual drawdowns to encourage the growth of moist soil plants. Drawdowns in the absence of chemical control can also increase the spread of Phragmites. Specific strategies to control Phragmites will be developed as part of the proposed Marsh Management Program. Classified hyperspectral imagery data (collected in summer 2000) will be used to estimate the current coverage of Phragmites.

Monitoring elements.—The number of acres of Phragmites treated. Evaluate treated areas to determine the degree of control, the response of natural vegetation, and how the treatments affect the use of the treated areas by wildlife.

Objective 2.1.6. Control purple loosestrife, johnsongrass, and Canadian thistle wherever they appear on Blackwater NWR by 2008.

Basis of the objective.—Purple loosestrife (*Lythrum salicaria*), an exotic plant that was first observed on Blackwater in 1996, is a wetland invader that competes with beneficial native plants. Control on the refuge has involved digging up the plants and spot applications of glyphosate (Roundup®).

Johnsongrass (*Sorghum halepense*) is listed as a noxious weed by the State of Maryland. This species, a product of introgression with *S. bicolor*, forms weedy hybrids with cultivated sorghum and is poisonous to mammals. Refuge staff have spot-treated Johnsongrass with glyphosate in refuge fields as required by Maryland law.

The State of Maryland lists Canadian thistle (*Cirsium arvense*) as a noxious weed. This species is poisonous to mammals. Refuge staff have spot-treated Canadian thistle with glyphosate (Roundup®), as required by Maryland law.

Strategies to achieve the objective.—These three injurious species are associated primarily with the moist soil management units and croplands. All three can be successfully controlled with the spot application of glyphosate. However, constant vigilance is required on the part of refuge staff to maintain the advantage of early detection. It may be necessary to consider the use of biological control agents developed by the Plant Protection Section (Maryland Department of Agriculture). Of the three species, agents have been identified only for Canadian thistle; these include several insects (*Cassida rubiginosa*, *Ceutorhynchus litura*, *Cleonis piger*, *Rhinocyllus conicus*, *Urophora cardui*, *Larinus planus*), and two diseases (*Puccinia punctiformis*, *Pseudomonas syringae pv. tagetis*). The refuge will continue the current policy, established in 1989, of no insecticides in its farming program.

Monitoring element.—The occurrence of individual plants.

Subgoal 2. Protect , enhance, and restore natural diversity of communities, sensitive species, and associated ecosystem processes in the Blackwater and Nanticoke watersheds.

Objective 2.2.1. By 2012, develop specific inventory, assessment, and management programs for rare, sensitive, and declining species; species of special concern; and rare and unique community types.

Basis of the objective.—In the Nanticoke watershed, the Maryland and Delaware Natural Heritage Programs have documented more than 200 plant species and almost 70 animal species categorized as biologically significant: e.g., TNC designations G1 through G5, and S1 through S3. For a complete list, see appendix C, "Rare Species in the Nanticoke River Watershed." The Nature Conservancy has identified high quality examples of several globally and

nationally unique types of communities, including Xeric Dunes, Atlantic White Cedar Swamps, Coastal Plain Ponds, (e.g., Carolina Bays or Delmarva Bays), Rich Woods, Coastal Plain Bogs, and Wet Meadows.

The Maryland program has designated two Maryland Natural Heritage Area sites within Blackwater NWR: the Upper Blackwater River and Gum Swamp. Numerous rare, threatened or endangered plants or animals occur within the Blackwater River watershed. In addition to migratory birds, Blackwater NWR has a clear mandate to protect, manage, and restore habitats that support listed species.

Strategies to achieve the objective.—The most important need is development and implementation of the Resource Inventory and Monitoring Program, to help determine the occurrence and distribution of floral and fauna on the Refuge Complex. We will arrange contracts with experts at the Heritage Program, USGS–BRD, or universities, for surveys of listed species and species that are uniquely difficult to detect. We will implement the appropriate tasks identified in existing recovery plans for Federal- and State-listed species. The development of the Habitat Management Plan will provide opportunities to evaluate the effects of management practices (e.g., TSI, prescribed fire) on species of concern.

Monitoring element.—Species occurrence. The acres of habitat under Service protection and management; the approved Habitat Management Plan; the mapping and assessment of hydrological modifications within the watershed; and, the number of surveys, censuses, and inventories funded, underway, or completed.

Objective 2.2.2. Provide and manage habitats for State-listed resident and migrating butterflies by 2010.

Basis of the objective.—At least four State-listed lepidopteran species likely occur on Blackwater NWR; they are known to occur on the Delmarva peninsula, and their host plants grow on the refuge. Larvae of two endangered species, the frosted elfin (*Incisalia irus*; G3/G4/S1) and regal fritillary (*Speyeria idalia*; G3/S1) feed on wild indigo (*Baptisia tinctoria*) and violets (*Viola spp.*), respectively. Larvae of two threatened species, the rare skipper (*Problema bulenta*; G2/G3/S1) and king's hairstreak (*Satyrium kingi*; G3/G4/S1) feed on *Spartina cynosuroides* and horse-sugar (*Symplocos tinctoria*), respectively. The need to document the occurrence of lepidopterans on the refuge should be apparent.

Strategies to achieve the objective.—We will document the occurrence and distribution of lepidopterans as part of the Refuge Complex Resource Inventory and Monitoring Program, or, alternatively, contract it as a discrete survey to a university or the Heritage Program. Both the draft Forest Management Plan and the proposed Marsh Management Plan will consider strategies to improve the distribution and abundance of host species used by State-listed species.

We will need to evaluate the crops we now grow for use by waterfowl as host species for lepidopteran larval and adult forms. For example, clover (*Trifolium spp.*), which is a protein source for migrating geese, hosts alfalfa butterflies (*Colias eurytheme*). Black willow (*Salix nigra*), which provides thermal cover for wintering dabbling ducks, hosts mourning cloaks (*Nymphalis antiopa*). Similarly, hackberry (*Celtis occidentalis*), which may be planted on dredge spoil to create roost sites for colonial waterbirds, hosts hackberry butterflies (*Asterocampa celtis*). Clearly, opportunities exist to modify existing management activities to more fully benefit nontarget lepidopterans. Successfully implementing the resident Canada goose control program will minimize grazing on clover, and allow this host plant to flower. Establishing a demonstration butterfly garden at the Visitor Center will not only serve an educational purpose, but also permit incidental observations of visiting butterfly species to be used to supplement inventory data.

Monitoring element.—Inventory program, contracted survey.

Objective 2.2.3. Maintain and restore hydrology and water quality as appropriate by 2010.

Basis of the objective.—Blackwater NWR maintains one of the most extensive and intact estuarine systems remaining on the Eastern Shore. However, many are concerned about the loss of 7,000 acres of emergent wetlands since 1933, the effects of sea-level rise and salt water intrusion on palustrine forested wetlands, nutrient runoff from wastes produced by animal feed operations, and the degradation of water quality and freshwater or anadromous

fisheries on the upper reaches of the Blackwater River due to saltwater intrusion from Stewart's Canal. These are significant environmental quality issues that negatively affect ecosystem processes and associated biota.

Strategies to achieve the objective.—We will develop and implement restoration tasks to be identified in the Habitat Management Plan. Implement management recommendations stemming from the ongoing CBFO study to evaluate the contribution of commercial poultry and swine operations to phosphate, nitrate, trace metal, and estrogenic compound levels in the Little Blackwater River.

Monitoring element.—Measurement of salinity and other water quality parameters.

Objective 2.2.4. By 2008, develop a Habitat Management Plan to address the issues of marsh loss and marsh management.

Basis of the objective.—The need to develop an HMP is critical, because of the significant loss of marsh, the emphasis on marsh restoration, the need to preserve community diversity, the increasing numbers of invasive and exotic species, the large number of threatened and endangered species, and the contribution of the refuge estuarine wetlands to the Bay ecosystem. Blackwater NWR sustains the northernmost expanse of three-square bulrush. Blackwater NWR also continues to maintain tremendous wetland diversity; more than 30 percent of its land is within two Maryland Natural Heritage Area sites, the Upper Blackwater and Gum Swamp. Federal-listed sensitive joint-vetch (*Aeschynomene virginica*; G2/S1) and State-listed rare skippers (*Problema bulenta*; G2/G3/S1) almost certainly occur within the estuarine marshes of Blackwater. To protect, restore, and enhance this diversity, a comprehensive Habitat Management Plan must be developed.

Strategies to achieve the objective.—Restoration strategies will include plugging Stewart's Canal to reduce saltwater intrusion, modifying Shorter's Wharf Road to allow sheet flow, implementing recommendations from the Nutria Pilot Study to reduce nutria herbivory, implementing the “Integrated Wildlife Damage Management Plan” for resident Canada geese, maintaining the muskrat trapping and nutria rebate program, riprapping the pine islands, reducing sediment load run-off into the upper watersheds, and thin-layer placement of dredged material. Strategies for maintaining and improving floral composition will include the use of prescribed fire to affect regrowth vigor and species composition, the use of pesticides to control invasive flora (in particular, purple loosestrife and Phragmites), and replanting in conjunction with techniques such as thin-layer dredged material placement. The development of the Habitat Management Plan must be superseded by implementation of the Complex-wide Resource Inventory and Monitoring Program, and by vegetation classification of hyperspectral imagery to the community level.

The HMP also must include a significant monitoring component due to the dynamic history of the marsh and the planned restoration strategies. LIDAR technology could be used to create fine-resolution Digital Elevation Models (DEMs); this will be the basis for an accurate elevation base map of the refuge, critical for making predictions and assessments of various restoration strategies. Relative Elevation Modeling (REM) will allow the refuge to predict the ability of wetlands to build vertically at a pace equal to sea-level rise. Landscape modeling of habitat change will link the refuge GIS data and wetland ecosystem process models; this will help to predict the impacts of restoration efforts at specific places on the refuge and to target critical areas for intensive management. The current rates of wetland elevation change and sedimentation need to be monitored; this is essential if the refuge is to understand current accretionary dynamics and the impact of different management practices.

Monitoring element.—Completion of a baseline flora inventory, classification of hyperspectral imagery, and approval of the Habitat Management Plan. Although not a prerequisite for completion of a Habitat Management Plan, the funding and completion of a DEM and REM for the Refuge Complex will contribute significantly to the technical merit and prioritization of restoration strategies outlined in the Habitat Management Plan.

Objective 2.2.5. By 2017, protect, restore, and conserve riparian habitat as lands are protected.

Basis of the objective.—The functions of riparian areas include water quality improvement, aquatic habitat, stream shading, flood attenuation, shoreline stabilization, and groundwater exchange. Loss of these systems allows for a more direct contribution of non-point source pollutants to receiving waters. The pollutant removal functions associated with wetlands and riparian area vegetation and soils combine the physical process of filtering and the biological processes of nutrient uptake and denitrification (Lowrance, et al., 1983; Peterjohn and Correll, 1984).

Riparian forests, for example, have been found to contribute to the quality of aquatic habitat by providing cover, bank stability, and a source of organic carbon for microbial processes such as denitrification (James, et al., 1990; Pinay and Decamps, 1988). Riparian forests have also been found to be effective at reducing instream pollution during flood flows (Karr and Gorman, 1975; Kleiss, et al., 1989). As importantly, restoration of the riparian areas will minimize disturbances to wildlife and provide additional breeding, feeding and sheltering areas.

Strategies to achieve the objective.—We will seek all opportunities to restore, conserve, manage, and protect riparian systems through a combination of land acquisition, forging partnerships, using existing resource management and related plans, and a significant inventorying or monitoring effort to initially assess status and trends.

Management strategies in this plan will involve restoration, manipulation to achieve desired future conditions, or protecting existing habitat functions and values. Invasive species management, primarily *Phragmites australis*, will be incorporated.

Monitoring element.—Amount (acres) and quality (composition, structure) of available habitat and wildlife responses; number of miles of riparian habitat acquired or restored; implementation of the division Resource Inventory and Monitoring Plan; acquisition and maintenance of current remote sensing and GIS layers; approval of Forest Management Plan.

Objective 2.2.6. By 2022, protect, enhance and restore current and historical Coastal Plain Atlantic white cedar swamps along the Nanticoke River.

Basis of the objective.—Atlantic white cedar has been classified as globally rare or threatened throughout its historic range and given a G-3 ranking by The Nature Conservancy. Therefore restoration and management of this vegetative alliance are high priorities within the Fish and Wildlife Service and other Federal land management agencies.

Strategies to achieve the objective.—We will determine the historic distribution of Atlantic white cedar within the Nanticoke River watershed with particular emphasis on distribution on division lands. We will assess alterations in land use patterns to determine effects if any on the current distribution of Atlantic white cedar. We will assess alterations in hydrology which may have impacted site conditions and soil properties to the point which they no longer support this vegetation community. We will join forces with the Atlantic White Cedar Alliance, TNC, other Federal, state and local agencies, academia and NGOs to develop and implement restoration and management strategies. Specific restoration and management strategies may include but are not limited to restoring the hydrology on a site by site basis to mimic natural conditions, harvesting hardwoods and pines from lands which were historically dominated by cedar and regenerating these sites through planting or natural seed sources where mature cedars are present and controlling competing vegetation in regenerating cedar stands.

Monitoring element.—A detailed GIS that displays the historical and present-day distribution of Atlantic white cedar within the Nanticoke River watershed. A data set that includes information on the current status of existing cedar stands and incorporates restoration needs into the Forest Management Plan for the Nanticoke protection area.

Goal 3. Create the most complete network of protected lands within the Chesapeake Bay watershed.

Subgoal 1. Strategic growth and protection of Blackwater NWR

Objective 3.1.1. By 2022, protect an additional 31,314 acres described in our approved LPPs.

Basis of the objective.—Protecting that land will contribute to the resource conservation goals of a variety of international, national, and regional initiatives, including RAMSAR, IBA, NAWMP, and the National Wetlands Priority Conservation Plan. Protection supports objectives of the Management Plan for Canada Geese in MD, the Chesapeake Bay Waterfowl Policy and Management Plan, and workgroup recommendations by the Chesapeake Bay Program Living Resources Subcommittee. The protection and improvement of habitats in this area are seen to be critical steps in the North American Waterfowl Management Plan, which specifically recommends protection of

53,500 acres and the improvement of an additional 5,000 acres in the Blackwater–Nanticoke protection area by the year 2000.

The Nanticoke River is listed in the Emergency Wetlands Resource Act Regional Concept Plan, and is a landscape project supported by The Chesapeake Bay Estuary Program. The Nature Conservancy has recognized the lands within our Nanticoke protection LPPs as a bioreserve and a Last Great Place; the State has designated the Nanticoke River as a Wild and Scenic River. The Nature Conservancy has developed the "Nanticoke River Bioreserve Strategic Plan" (1998) which outlines the biological significance of the watershed and its threats. More than 23 Natural Heritage sites lie within the project, which also contains the largest contiguous forest remaining on the Delmarva Peninsula.

Strategies to achieve the objective.—We will seek opportunities to conserve, manage, and protect lands through a combination of land acquisition; easements; forging partnerships with State agencies, land trusts, and other landowners; and, developing agreements with other entities holding title or other rights or interests in land in targeted areas of the watershed. The use of hyperspectral imagery to remotely identify significant habitats and the use of LIDAR to evaluate the potential effects of sea-level rise will help greatly in prioritizing our land protection. The use of GIS to delineate the effective areas of forest cores will also help in strategic protection. We will develop an MOU with National Park Trust to facilitate and accelerate Complex-wide land protection.

Appendix B, "Land Protection Plan," describes the concepts of the Service land acquisition program and its acquisition priorities, the relationship of land protection to achieving goals and objectives in national and regional habitat plans for trust resource species, collaborative science-based conservation planning, alternative approaches to land acquisition, the role of landscape-level biological planning in developing priorities, the benefits to specific conservation targets (species and ecosystem types), how proposals promote biological integrity, the review of Comprehensive Environmental Response Cleanup Liability Act responsibilities and issues, recreational guidelines and improved access issues for additional wildlife dependent recreational activities, and operational and maintenance costs.

Monitoring element.—Annual acres protected; acquisition and analyses of remote sensing or GIS layers.

Objective 3.1.2. By 2007, continue to assist partners in developing a landscape protection plan.

Basis of the objective.—Population growth, fragmentation, and other, related land use changes must serve as an important backdrop in our CCP. These forces ultimately result in fundamental changes to fish, wildlife, and plant populations and to ecosystem processes; they affect land acquisition efforts; they create logistical problems in land management, maintenance, and law enforcement; and, they produce significant recreational demands and pressures on the Refuge Complex. The collective efforts of many different agencies, entities, and non-governmental organizations already are protecting and conserving many unique and important habitats, communities, and species in the watershed.

The salient issue is what role the Refuge Complex (and each refuge) should play as part of the emerging, larger, interconnected system of protected lands within the watershed. The Service alone cannot acquire or otherwise conserve the resources within the Blackwater River watershed. The success of management and conservation of biological diversity and efforts to maintain or restore the integrity and health of ecosystems and communities will rely upon partnerships.

Strategies to achieve the objective.—We will assist in developing Maryland's GreenPrint Program; participate in implementing the Chesapeake 2000 Agreement; work with local, state, and regional government acquisition or easement initiatives on strategic partnerships to maximize and coordinate land protection; acquire, restore, or otherwise protect forested corridors to connect refuge land with other protected land; participate in the Chesapeake Bay and Susquehanna River Ecosystem Land Protection Plan; and, develop an MOU with National Park Trust to facilitate and accelerate Complex-wide land protection. We will assist the Maryland Wildlife and Heritage Service with the development of its comprehensive Wildlife Diversity Conservation Plan, whose purpose is to identify the important places on the Maryland landscape where conservation is needed to sustain wildlife diversity and the actions necessary to conserve this diversity, focusing on fish and wildlife species of greatest conservation need.

Monitoring element.—The number of acres and the quality (composition, structure) of available habitat protected and managed; and, the number of partnerships and initiatives created.

Goal 4. Develop and implement quality scientific research, environmental education, and wildlife-dependent recreation programs that raise public awareness and are compatible with refuge purposes.

Subgoal 1. Encourage and provide opportunities for research by other agencies, universities, and other institutions, especially, research that relates to the mission, management, and objectives of Blackwater NWR.

Objective 4.1.1. Foster relationships with government entities, conservation groups, and institutions, communicate the most critical research and management needs of the refuge, and provide at least five research opportunities by 2012.

Basis of the objective.—One of the important purposes of Blackwater NWR is priority scientific research, which we define as studies that contribute to the enhancement, protection, uses, preservation, and management of native wildlife populations and their habitats in their natural diversity (4 RM 6). The Service encourages and supports research that provides additional data upon which to base decisions on managing units of the Refuge System (4 RM 6). We need to provide opportunities for research and management-applied studies, which are crucial to sound resource management.

One of our objectives is to provide students and others with the opportunity to learn the concepts of field research (4 RM 6). Providing research opportunities to universities, colleges, and other institutions will enhance the education of students pursuing wildlife, archaeological, or other degrees (see subgoal 2, below). The information they provide the refuge on wildlife-habitat relationships and other topics will further environmental education and interpretation and wildlife conservation.

Strategies to achieve the objective.—We will actively seek partnership opportunities, and consider unsolicited proposals for research in a variety of disciplines, including flora and fauna, public use, and cultural resources. All reports, surveys, and scientific papers generated will be made available to refuge staff and cataloged for future needs.

We will communicate to the institutions above, the priority information gaps we seek to fill, e.g., the effects of human activities on wildlife and habitats, and habitat needs of species of special concern, with priority given to studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats in their natural diversity (4 RM 6). We will also permit the refuge to be used for other investigatory scientific purposes, when such use is compatible with the purposes, goals, and objectives of the refuge. Priority will be given to research studies that contribute to the enhancement, protection, uses, preservation, and management of native wildlife populations and their habitats in their natural diversity (4RM 6).

We will specifically create new and innovative partnerships with U.S. Geological Survey and the Fish and Wildlife Cooperative Research Units (University of Maryland Eastern Shore and others) to achieve information needs and to evaluate management actions. Refuge staff will identify research needs, collaborate with researchers where and when appropriate and feasible, provide facilities and support as defined in objective 4.1.2., and routinely author and co-author publications.

Monitoring element.—The number of published research projects supporting refuge objectives.

Objective 4.1.2. Maintain refuge facilities, equipment, and lands for potential use by researchers, interns, students, and other conservation partners by 2008.

Basis of the objective.—Providing facilities and equipment facilitates research, as housing and travel costs can be significant components of research budgets.

Strategies to achieve the objective.—Housing, equipment storage, and use of Service equipment will be provided at the discretion of the Project Leader, with priority given to research that furthers the goals and purposes of the refuge. We will seek partnerships with the Friends of Blackwater to purchase new facilities or renovate existing ones.

Monitoring element.—Inventory of facilities available for researchers, listing of habitats used during research.

Subgoal 2. Provide opportunities for environmental education and interpretation that meet the needs of users.

Basis of the subgoal.—The Refuge System Administration Act and the NWRSIA direct us to provide opportunities for the priority general public uses of the Refuge System. Environmental education and interpretation are two of the six priority public uses. These uses advance public awareness, understanding, and appreciation of the functioning of ecosystems and the benefits of their conservation to fish, wildlife, and people. This ultimately contributes to the mission of the Refuge System.

Objective 4.2.1. Complete and distribute an environmental education manual by October 2009.

Basis of the objective.—Only one environmental education program is now available at the refuge. The refuge cannot meet the requests by school groups and scout, church, and 4–H groups. An environmental education manual will provide programs and activities for schools and other groups while increasing public understanding of wildlife needs, ecosystems, conservation, and habitat management for wildlife and, ultimately, the public use goal of the refuge.

Strategies to achieve the objective.—Refuge staff will edit and print section 1 of an environmental education manual by October 2008, section 2 by October 2010, and section 3 by October 2012. The manual will be distributed to schools and feedback gathered 1 year after each section is published.

Monitoring element.—The number of schools, teachers, and students that visit the refuge; assessment of how the manual meets their needs and expectations.

Objective 4.2.2. Annually provide two on-refuge teacher training programs.

Basis of the objective.—Many teachers do not have the background in environmental education and wildlife to teach the activities in the manual. Teacher workshops will enable them to learn how the activities should be conducted, what to expect to find at the refuge, and will provide background information for preparing the students for the various activities. A well-trained teacher will provide the necessary background for refuge environmental education, and focus on the importance of the refuge in wildlife habitat management, enhancing the refuge's ability to meet its environmental education goals.

Strategies to achieve the objective.—We will conduct two teacher workshops each year.

Monitoring element.—The number of teachers attending workshops; teacher assessment of the education manual; effectiveness of the training.

Objective 4.2.3. By 2012, develop specialized programs and provide the 15 types of environmental education programs identified in the environmental education manual for 150 groups of students.

Basis of the objective.—Refuges are learning laboratories, and Service programs are designed to show students and teachers the value of fish and wildlife resources. There is now only one refuge-specific environmental education program available for teachers, 4–H clubs, scouts, home schoolers, college students, and others. The refuge has not been able to meet the requests for special programs for all these groups. With 15 environmental education programs geared toward each of the different types of groups and their needs, the refuge will provide the programs requested.

Strategies to achieve the objective.—We will develop environmental education programs that can meet requirements of boy scouts, girl scouts, 4–H clubs, home school groups, college programs, programs for adults, and special event programs to be available when needed by 2012.

We will implement the environmental education manual and refuge activities for elementary-age visiting groups by October 2008; for middle school groups by October 2010; and high school groups by October 2009.

We will develop three changeable environmental education activities for the refuge web page by January 2010, and alternate programs every 6 months.

Monitoring element.—The number of environmental education programs and students per year, and assessment of how well the environmental education program and manual meet their needs and expectations.

Objective 4.2.4. Develop adequate facilities and equipment for environmental education study compatible with wildlife management purposes of the refuge by 2014.

Basis of the objective.—No facilities are adequate for providing environmental education programs year-round. Building such a facility will greatly enhance the capability of the Refuge Complex to administer its environmental education program, and, ultimately, achieve the public use goal of the refuge.

Strategies to achieve the objective.—We will purchase the Robbins property to construct an environmental education outdoor classroom, and purchase equipment and materials to use for environmental education. We will build a contact station for the Nanticoke protection area along Route 50 on a site yet to be determined; and by 2017, we will build an outdoor classroom facility.

Monitoring element.—Completed construction of the facilities and purchase of equipment; and the number of visitors or groups using each facility or location.

Objective 4.2.5. Increase interface with the education community, non-government organizations, universities, and other state and Federal agencies by 2010.

Basis of the objective.—No staff are available for coordinating volunteer services, even though we recognize the crucial link between public awareness and effective management of the Refuge System. The Volunteer and Community Partnership Act requires us to develop guidance for refuge education programs to further the mission of the Refuge System and the purposes of individual refuges. The Act encourages cooperative efforts with state and local education authorities and partners to develop and implement these programs.

Strategies to achieve the objective.—We will develop five shared education programs and activities with other environmental education centers (Horn Point EE Center, Karen Noonan EE Center, Pickering Creek EE Center, and universities) by October 2014; foster opportunities for the participation of students, co-ops, SCEPS, interns, and SCAs; participate in community and other government-agency-sponsored events; expand our participation in the envirothon for high schools; develop an MOU with Henson Scout Camp and the 4-H Camp Thendera to work together on environmental education and interpretive programs and events; and, develop an envirothon for middle and elementary schools.

We will improve communications by planning and conducting workshops and meetings with other environmental education interests (the education community, non-government organizations, and other agencies); share information and ideas; and, assist with environmental education activities. We will continue to work with the Nanticoke Watershed Alliance on special programs involving environmental education and outreach; and expand our volunteer network and friends groups.

Monitoring element.—The number and types of partnerships developed, number of programs established, and number of participants in these programs.

Objective 4.2.6. Provide qualified educators and volunteers to conduct environmental education and interpretation programs by 2010.

Basis of the objective.—The System must have professional public use planners and specialists in recreation, interpretation, and education to provide the American people with more and better opportunities to enjoy compatible wildlife-dependent experiences on refuges. Trained professionals will be able to educate the public in a manner that visitors of all ages can enjoy while learning about wildlife, their environment, conservation, and refuge management.

Strategies to achieve the objective.—In addition to the supervisory ORP and the permanent full-time Recreation Aid or Park Ranger (position vacant since 1989), we will hire a permanent full-time ORP to recruit and train interns and at least 30 volunteers a year, and assist with the environmental education program. We will hire two additional permanent full-time ORPs and one additional ORP for the Nanticoke protection area. We will provide trained professionals and volunteers the opportunity to attend appropriate environmental education training.

Monitoring element.—The number of trained professionals, volunteers, and students providing environmental education.

Objective 4.2.7. Provide 100,000 hours of interpretation to enhance visitors' knowledge of wildlife and refuge management, while providing an enjoyable refuge experience by 2017.

Basis of the objective.—Refuges are the front yards of the Refuge System, and provide people the opportunity to experience its diverse environmental education and interpretation activities at first hand. Refuges provide visitors with an understanding and appreciation of fish and wildlife ecology and help people understand their role in the environment through interpretation programs and facilities. The refuge now provides 26,000 hours of interpretation annually. The refuge Visitor Center, self-guided Wildlife Drive, and associated interpretation trails (one self-guided) provide visitors some knowledge of wildlife and refuge management and an enjoyable refuge experience. However, the Visitor Center is in poor condition, short of space, understaffed, and its exhibits are outdated. We cannot meet the increasing number of requests for more activities, programs, demonstrations, and special events. Programs will need to be created to specifically target the Nanticoke protection area resources. Improving facilities, staffing, and programs will greatly enhance our capability to administer interpretation programs, and ultimately achieve the wildlife-dependent education and recreation goals of the refuge.

Strategies to achieve the objective.—By 2008, we will remodel and expand the Visitor Center to include a larger multipurpose room for 150 people; a second-floor observation area with observation telescopes; an environmental education area; new office space for four ORPs or Park Rangers, seasonal or temporary staff, interns, and the volunteer program; sales outlet space for FOB; fire-safe storage for historical items; and, a larger exhibit area.

We will update present kiosk information panels and provide two more kiosks by 2010: one at the entrance to the new Wildlife Drive location, and one at the Nanticoke River contact station to provide interpretive information on Nanticoke protection area resources. We will provide a panel in the Woods Trail kiosk explaining the history of the steam engine; construct trailheads with kiosks at new hiking, canoeing, and biking trails by October 2007; install interpretive signs in new hiking, biking, and canoeing areas and other areas as needed; and, catalog and store all slides, photos, and historical items.

The refuge will serve as an NPS Gateways Site. We will install an indoor interactive computer console in the Visitor Center by October 2008; install an outdoor interactive computer console by 2014; install a live action monitor of eagle and osprey nests with educational exhibits by 2009; produce a new refuge film in 2012; a Nanticoke film by 2014; and, purchase new videos applicable to the refuge for use in the Visitor Center and Nanticoke Contact Station.

We will develop new, updated exhibits for the Visitor Center and Nanticoke Contact Station, which will be open every day but Christmas Day and Thanksgiving Day; revise the Mammals and Wildlife Drive Guide leaflets to FWS standard format; produce a self-guided Woods Trail leaflet, Nanticoke leaflet, volunteer leaflet, and exotic species leaflet by October 2012; produce an endangered species leaflet and entrance fee leaflet by October 2014; and, produce other leaflets as needed.

We will construct a ¼–mile bicycle trail from the Wildlife Drive to Key Wallace Drive. In partnership with the highway department, we will build a 3-mile bike path from the Wildlife Drive to Hip Roof Road. We will build a butterfly garden by October 2008; establish a habitat demonstration area by October 2009; and, provide bat housing in silos at Hog Range.

Monitoring element.—The number, type, and location of facilities or activity, and the response by refuge visitors (the number of hours, number and type of visitors or groups using each facility, location, or activity).

Subgoal 3. Provide opportunities for compatible wildlife-dependent recreation.

Basis of the subgoal.—The NWRSIA directs us to provide six priority wildlife-dependent recreational uses in the Refuge System: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. By providing the public with opportunities for those uses, we will increase public awareness, understanding, and appreciation of ecosystem functions and the benefits of ecosystem conservation to fish, wildlife, and people. Ultimately, these will contribute to the mission of the Refuge System.

Objective 4.3.1. By 2012, increase the opportunities for wildlife observation and photography.

Basis of the objective.—During scoping meetings, the public requested that we increase wildlife observation and photography opportunities. Achieving this objective will provide the public with the opportunity to view the relationships among resource management, wildlife and habitat, and people.

Strategies to achieve the objective.—By October 2008, we will redesign the Wildlife Drive to start from the Visitor Center and finish at its present entrance, to give visitors a better wildlife observation experience, and enable them to get information and assistance from staff and volunteers at the Center before entering the drive. We will convert the Pool 5 section of the drive to non-motorized use, to allow a separate area for pedestrians and bicyclists that will not conflict with motorists, thereby improving visitor safety. We will also build a new parking area for visitors who wish to bike or hike.

By October 2017, we will build a wildlife observation trail from Route 335 to Smithfield Road (Gum Swamp Trail), with parking facilities. We will install benches along all wildlife observation trails to allow visitors to rest and enjoy wildlife.

By January 2012, we will replace the observation tower with an accessible deck over wetlands and an elevated observation platform at water's edge at the junction of the Little Blackwater River and Blackwater River, to be used for environmental education programs and by visitors to view the wetlands.

By January 2012, we will install six observation and photo blinds and provide a photography program for the public for each season of the year.

By 2009, we will build a second-floor observation deck and install observation telescopes at the Visitor Center.

By 2017, we will build a wildlife observation trail and observation tower on the Nanticoke.

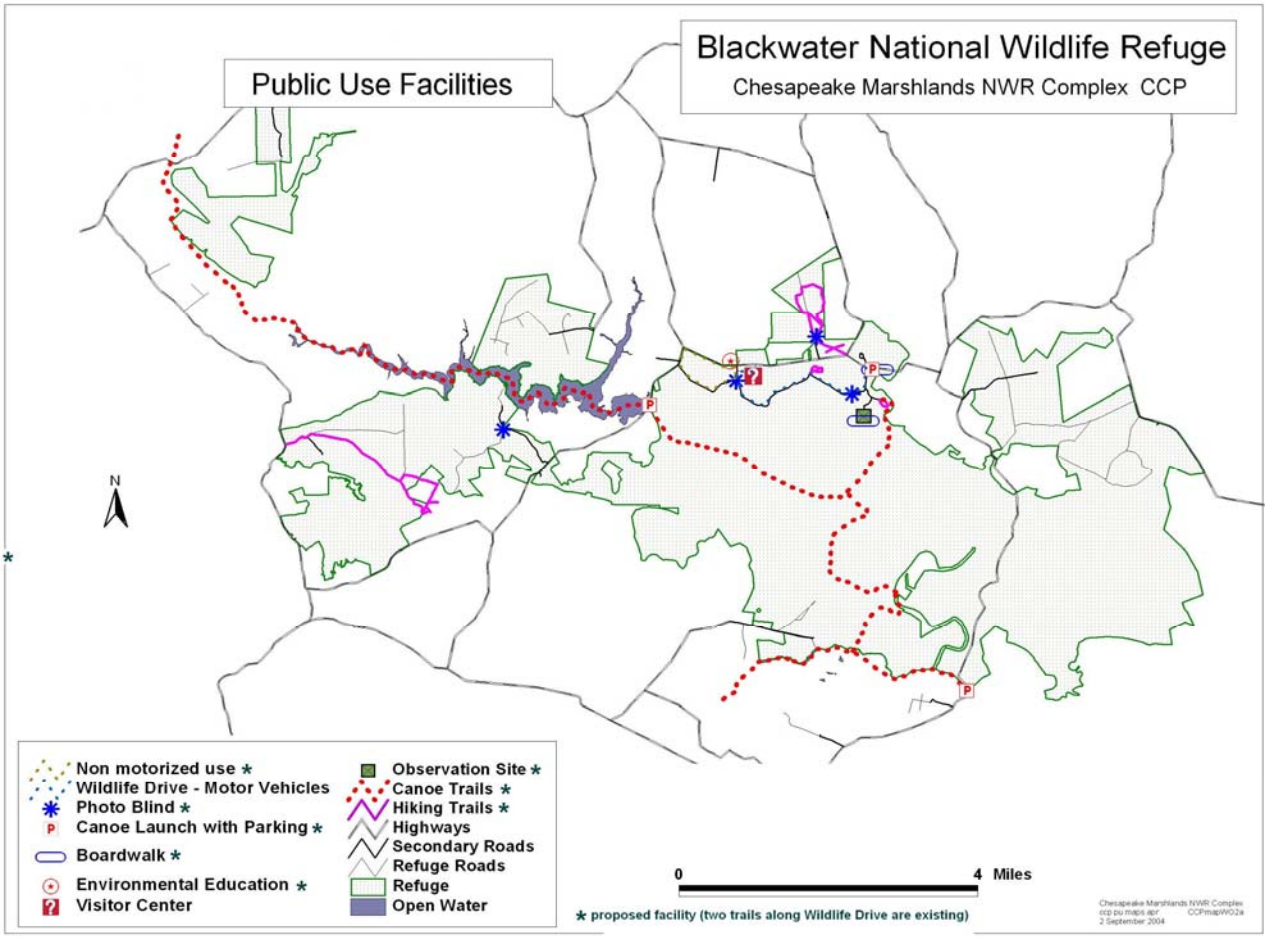


Figure 4.1. Public Use Facilities

Objective 4.3.2. Provide increased fishing opportunities by 2017.

Basis of the objective.—The demand for safe, adequate fishing opportunities is increasing.

Strategies to achieve the objective.—By January 2007, expand areas closed to boating, using State regulations. By 2008, in partnership with the State of Maryland, we will build a canoe access ramp and controlled parking area at the Route 335 bridge, and encourage the Friends of Blackwater or a concessionaire to provide canoe and kayak rentals.

By January 2009, we will mark river channels on Blackwater River, and, by January 2014, we will build an accessible boardwalk or pier, kiosk, designated fishing and crabbing area, and parking area on the Little Blackwater near Key Wallace Bridge.

By 2017, we will construct a canoe access ramp with controlled parking area, and build an accessible boardwalk or pier near the Nanticoke River.

By January 2017, we will map waterways for public safety, monitor canoeing and boating activities, provide interpretive fishing, crabbing, and boat safety programs, develop National Fishing and Boating Week activities for the public, and develop signs and printed materials explaining Blackwater NWR rules and regulations to visitors.

Monitoring element.—The number, type, and location of facilities constructed, and response of refuge visitors, by season (number of visitors using each of the facilities—pier, canoe ramp, parking).

Objective 4.3.3. Provide additional opportunities for high quality hunting experiences.

Basis of the objective.—The need to provide hunting opportunities compatible with the resource is increasing. At our scoping meetings, the public recognized hunting as a traditional, family-oriented form of recreation, important in developing an appreciation for fish and wildlife, and recommended more opportunities for big game, small game, and waterfowl hunting.

Strategies to achieve the objective.

Big game hunting.—We will open 10,430 acres of existing refuge land to big game hunting, and open additional acreage as we acquire it.

Beginning the last Saturday in September and ending the third Saturday in January, we will permit big game hunting for sika and white-tailed deer for a minimum of 51 days: 43 days of archery hunting; 2 days of muzzleloading rifle or shotgun hunting; 2 days of youth-only shotgun hunting; and 4 days of shotgun hunting; all within State seasons and in conformance to State weapons and bag limits.

During the archery seasons, hunters will walk in from existing, designated parking areas, and all vehicle access will be prohibited. During firearms seasons, vehicles will be restricted to designated roadways. There will be no off-road vehicles or ATV use allowed during any hunting season. There will be no access allowed by boat during any of the big game hunting seasons. The first section of the Wildlife Drive will be closed the first 2 days of the shotgun hunt, leaving the second part open for public use.

We will provide hunting opportunities to a minimum of 3,000 hunters annually, on a first-come, first-served, mail-in system (non-quota for the archery season, but "with quotas" for the firearm hunts). Hunters will be restricted to zoned areas for safe distribution, with a ratio of no more than 1 hunter per 20 acres, although some areas may have only 1 hunter per 40 acres. Staff and volunteers will operate check stations during muzzleloader and shotgun hunts to obtain deer age, sex, species, and weight data. We will require hunters who kill deer during the archery season to have them checked at a Maryland DNR-certified checking station.

Before July 1, we will prepare and submit for review an annual hunt plan. We will publish summaries of the biological information in the refuge Annual Narrative Report. Administrative fees will be charged for the permits. Senior citizens will receive a 50-percent discount on those fees. We will use those fees to hire a hunt coordinator and maintain parking areas and signs.

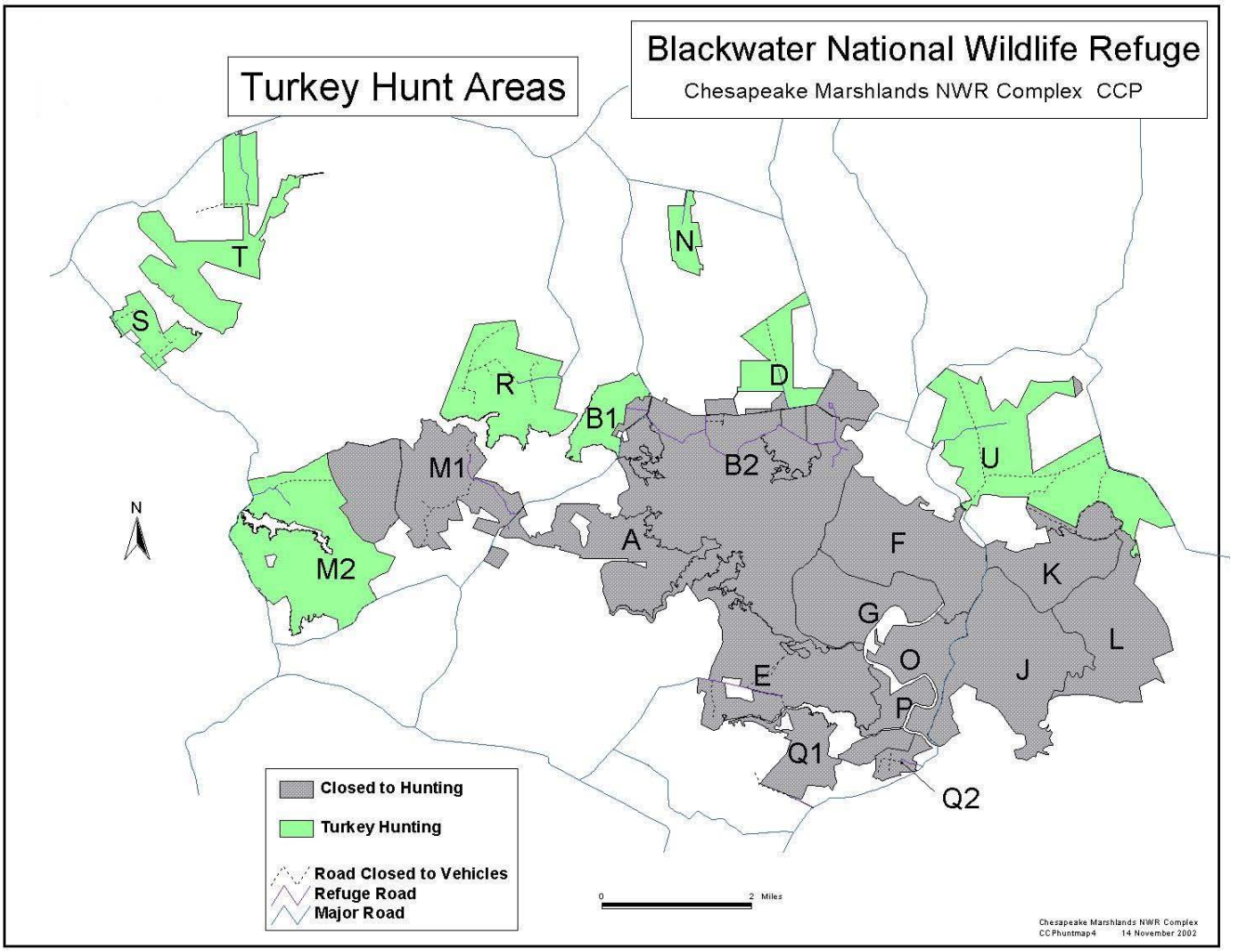


Figure 4.2. Turkey Hunting Areas

One area of the refuge will be designated for certified wheelchair-bound big game hunters. Hunt leaflets, regulations, and maps will be prepared and published annually, and distributed to hunters. Refuge-specific regulations will be published annually in the Federal Register and codified in Title 50, Part 32. We will maintain a hunter data base to facilitate mailing and distributing information. Blackwater NWR will

continue the same precautions for threatened and endangered species and migratory waterfowl as proposed under alternative A of our draft CCP. Hunting will be regulated in time and space to eliminate conflicts with endangered species and other public uses, and to ensure compatibility with refuge purposes. Annual spotlight surveys, harvest data, herd health conditions, and available habitat will continue to ensure that the deer hunt program remains biologically sound.

Deer hunting to maintain herd numbers within acceptable levels will continue to provide opportunities to utilize a renewable resource. We will adjust refuge hunting seasons each year to take into consideration changes indicated in herd quality by biological monitoring (APCs, antler size, reproductive rates, etc.).

Forest game hunting.—By April 2008, we will open the refuge to turkey hunting in accordance with State regulations (see figure 4.2, turkey hunt areas). The refuge will be open to hunting on Tuesdays and Saturdays for 5 weeks during the State season (April 18 to May 23) on a quota basis. Turkey hunting will require a permit issued to 14 hunters per day (112 hunters), determined by a lottery system. We will also participate in the state junior turkey hunting program. The junior hunt is designated for hunters age 16 or younger only, who must be accompanied by a licensed (or exempt from license requirement) unarmed adult age 21 or older.

The hunt will take place on approximately 7,485 acres in 10 areas (Areas B1, D, M2, N, R. S. T, U1, U2, and U3), located where public use will not occur, as specified in the Annual Hunt Plan. Scout days will be authorized the day before each hunt day. We will open new areas as they are acquired whenever hunting will not conflict with public use or endangered or threatened species (bald eagle), and will not have a negative impact on other wildlife and habitat resources or public safety. Hunting on newly acquired lands will conform to existing regulations. We will complete a compatibility determination before the hunt begins.

Waterfowl hunting.—By 2009, we will open Blackwater NWR to spring hunting of resident Canada geese (March 15 through April 15), according to the Annual Hunt Plan based on the "Integrated Wildlife Damage

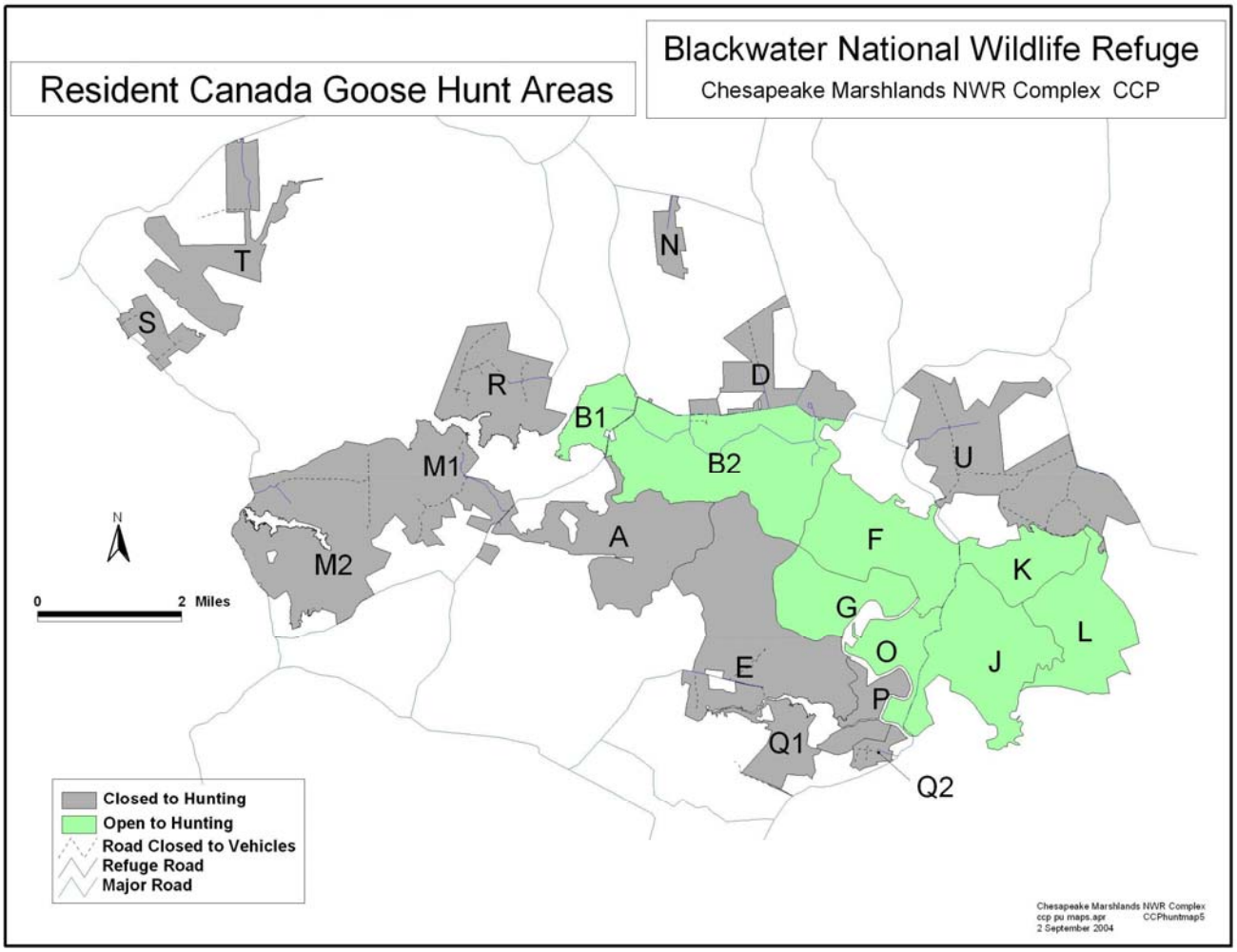


Figure 4.3. Resident Canada goose hunting areas

Management Plan for Control of Resident Canada Geese," if consistent with the Service EIS on managing these injurious resident waterfowl. Hunting will occur in areas that will not conflict with public use or endangered and threatened species (bald eagle), and will not have a negative impact on other wildlife and habitat resources or public safety (see figure 4.3, Resident Canada goose hunt areas). We will close the hunt areas to boating access by non-hunters during the hunting season.

Resident goose hunting will require a permit determined by a lottery system issued for 30 blind sites constructed by the hunter within 100 yards of a numbered post. The blind sites will be located in areas B1, B2, G, F, J, K, L, and O, on approximately 8,300 acres of marsh (3,731 acres), fields (70 acres), and open water (4,500 acres). Thirty permits per day (27 days) will be issued providing 810 recreational waterfowl hunting opportunities. New areas will be evaluated and considered as they are acquired whenever hunting will not conflict with public use areas or endangered and threatened species (bald eagle), will not have a negative impact on other wildlife and habitat resources, or adversely affect public safety. Retrievers will be permitted.

By 2012, waterfowl hunting in accordance with State seasons, species, bag limits, and hunting methods, will be permitted on 40 percent of all new acquisitions. This hunting opportunity will continue to maintain approximately 23,000 acres as an inviolate sanctuary for wintering and migrating waterfowl.

We will hire a full-time Refuge Law Enforcement Officer to enforce hunting regulations, in addition to other duties. The Friends of Blackwater will hire a full-time Hunt Coordinator to prepare updated mailing lists, regulations, maps and applications; mail out information, process applications, collect and record money; and, maintain the hunt areas, conduct the hunts, and collect and prepare records of hunt statistics.

Monitoring element.—The number and type of hunting experiences, and response of refuge visitors (number and type of visitors or groups participating in each hunt).

Subgoal 4. Enhance and increase outreach activities.

Basis of the subgoal.—In recognizing the crucial link between public awareness and effective management of the Refuge System, and in order to build a stronger base of public understanding, support, and activism beyond that portion of the American public who visit refuges, the Service has supported nationwide strategies, including the 100-On-100 Outreach Campaign, the National Outreach Strategy: A Master Plan for Communicating in the U.S. Fish and Wildlife Service, the NWRSIA, the Cooperative Alliance for Refuge Enhancement (CARE), the Volunteer and Community Partnership Act, and the Challenge Cost-Share Program. Enhancing and increasing outreach activities support this subgoal.

Objective 4.4.1. Increase public knowledge of the Refuge Complex and each refuge's existence, location, and activities. (See "Strategies," below, for completion dates.)

Basis of the objective.—Many people, including numerous local residents, are unaware of the refuge, its mission, and what it does. Increasing public knowledge of the refuge's existence, location, and activities will encourage more people to visit the refuge and become aware of the importance of refuge habitat management, wildlife, and conservation, to supporting the mission of the Service.

Strategies to achieve the objective.—We will install two travelers' information radio stations on Route 5: one near Cambridge by January 2007, and one near the Nanticoke River in Vienna by 2012. We will participate in local events, such as the Bay Country Festival, 4-H Fairs, Waterfowl Festival, Shad Festival, and other events as they develop; work with Dorchester County Tourism, South Dorchester Folk Museum, Harriet Tubman Organization, and other community organizations in events and activities as they are developed, and develop ecotourism programs at the Hyatt Regency conference center by October 2012.

We will develop better personal relationships with the media, develop a refuge monthly or weekly activity report for local newspapers and radio stations, and continue to work with Friends of Blackwater to seek funding, develop programs, produce projects, expand the cooperative sales outlet, plan and conduct public events, promote national projects and other activities as they develop, and respond to all public inquiries.

We will involve more people from the community in the Volunteer Program, participate in the development of watershed-wide cooperative outreach groups of Dorchester, Caroline, Somerset, and Wicomico Counties; continue to participate in the Nanticoke Watershed Alliance and Lower Shore Tributary Strategies Team; and develop an envirothon for middle and elementary schools by 2017.

Monitoring element.—The number of types of activities involving the communities, and the number of participants in each.

Subgoal 5. Ensure the compatibility of all public use.

Basis of the subgoal.—The Service is responsible for ensuring the compatibility of all public uses, in conformance with the Refuge Recreation Act of 1962 and the Refuge Administration Act of 1966, which place into law the concept that all refuges will be closed to all recreation uses, until we have determined that the uses are compatible with a refuge's establishing purpose(s), and that sufficient funds are available to administer those uses.

Objective 4.5.1. Provide public use opportunities that are compatible with the wildlife, resources, and purposes of Blackwater NWR by 2007.

Basis of the objective.—The NWRSIA calls for the Refuge System to provide increased opportunities for families to experience compatible, wildlife-dependent recreation.

Strategies to achieve the objective.—We will determine the compatibility of all new recreational uses.

Monitoring element.—The number of compatible determinations.

Objective 4.5.2. Provide adequate housing for interns and students (researchers and public use) by 2009.

Strategies to achieve the objective.—By 2007, we will set up and renovate a mobile home purchased by the Friends of Blackwater for intern and researcher residence.

By 2009, we will renovate and convert the old headquarters building to intern housing.

Objective 4.5.3. Develop adequate facilities and equipment. (See "Strategies," below, for completion dates.)

Strategies to achieve the objective.—By 2008, we will remodel and expand the Visitor Center to include a larger multipurpose room for 150 people; a second-floor observation area; and environmental education area; new office space for five ORPs or Park Rangers, temporary staff, interns, and volunteers; sales outlet space for FOB; and a larger exhibit area. We will construct a contact station on the Nanticoke River.

We will build two outdoor classrooms: one near the Wildlife Drive by 2009, and one at the Nanticoke River by 2017; and, purchase equipment and materials to use in environmental education.

By October 2009, we will build an improved loop hiking trail from Route 335 to Smithfield Road, with a parking area for visitors who wish to hike, and a parking area for visitors who wish to bike.

By January 2012, we will replace the observation tower that was removed in 1990 with an accessible deck and elevated observation platform over wetlands to water's edge at the junction of the Little Blackwater River and Blackwater River, and build three observation and photo blinds.

By January 2009, we will redesign the Wildlife Drive to start from the Visitor Center and finish at its present entrance, and convert the second part of the Wildlife Drive to a bike trail, which will connect with a bike trail to be built along Route 335 to Hip Roof Road by the MD Highway Department and Dorchester County.

Subgoal 6. Protect human health and safety.

Objective 4.6.1. Ensure that human health and safety are primary considerations in implementing refuge management activities.

Strategies to achieve the objective - Allowed public uses and many refuge management activities have undergone a compatibility determination that considers human health and safety prior to implementation.

One refuge management activity affecting public health and safety that relates to both our wildlife habitat and public use programs is mosquito control. In rare circumstances mosquitoes can serve as disease vectors presenting a threat to human health. West Nile virus and encephalitis are two examples of mosquito borne diseases that are a

public health concern. It is the policy of the National Wildlife Refuge System that we will allow native mosquito populations to function unimpeded and we may allow mosquito populations to be controlled only in the following circumstances:

There is a need to manage a public or wildlife health threat from a specific mosquito-borne disease that mosquito and disease monitoring data, collected by either the Service or state/local public health or mosquito control agencies, have documented as enumerated in Service policy.

There are tires, tanks, or other similar debris/containers that may serve as artificial breeding sites for native or non-native species of mosquitoes. We may remove these or treat them with pesticides.

We are enhancing, restoring, or managing habitat for other wildlife species to achieve refuge purposes. This may be in the form of habitat restoration or water level manipulations where there is a definable benefit to other wildlife over not undertaking such actions. We prohibit habitat modifications or management actions designed specifically for mosquito control that impact other wildlife species or habitats and are detrimental to refuge purposes or System goals. These modifications or actions include, but not limited to, inappropriate draining, maintaining high water levels that are inappropriate for wildlife, and the importing or enhancing of non-native predators.

There is a need to manage a threat to public health and safety from extreme numbers of biting mosquitoes when advised to do so by the Centers for Disease Control and Prevention (CDC) and/or the Federal Emergency Management Agency (FEMA). Such mosquito control may be necessary following natural or human-caused disasters when biting mosquitoes may hamper recovery efforts.

In cases of officially determined health emergencies, any method we use to manage mosquito populations within the refuge will conform to applicable Federal laws such as the Endangered Species Act. Habitat management and pesticide uses for mosquito control will give full consideration to the integrity of non-target populations and communities. They will also be consistent with integrated pest management strategies and with existing pest management policies of the Department of the Interior and the Service.

Goal 5. Ensure that the staffing, facilities, resource protection, and infrastructure necessary for implementing this CCP are developed.

Objective 5.1. By 2008, obtain base funding necessary to maintain minimum staffing and operational support of the refuge.

Basis for the objective.—The Refuge Complex staffing chart (see appendix D) identifies this refuge's minimal staffing level for basic resource inventory and monitoring to ensure the use of the best science in management decisions. Additional biological and maintenance staff are needed to maintain intact and diverse ecosystems, recover endangered species, and monitor populations status and trends. Law enforcement officers are necessary to ensure the safety of visitors and for resource protection.

Critical needs exist in the public use programs to respond to expected high levels of visitation and demands for opportunities for visitors to experience and appreciate wildlife. Existing equipment inventories are insufficient to effectively support existing or additional staff. Clearly, implementing this plan will require staff to effectively perform all identified public use, management, inventory, and maintenance programs identified in this plan.

Strategies to achieve the objective.—We will obtain congressional, national, and regional support for base funding for approved refuge projects; obtain local community support for implementing programs during the transition period, including expanding the use of volunteers and interns to accomplish programs and projects; and, seek opportunities for collaborative funding projects with partners. We have identified under goal 4, subgoal 5, objective 3 the public use infrastructure needed to accomplish our goals.

Monitoring element.—Achieve base funding level necessary to maintain minimum staffing and operations.

Chesapeake Island Refuges

Concepts Used in Developing Management Strategies

Land Protection.—This plan will expand potential management responsibilities at the island refuges through Cooperative Management Agreements and Memorandums of Understanding. We will welcome management agreements with the State of Maryland and the U.S. Navy for Bloodsworth, Adams, and Northeast Islands (U.S. Naval Reservation lands), and South Marsh Island (the MD DNR Wildlife Management Area).

Fish, Wildlife, and Habitat Management.—This plan will expand the Complex-wide Resource Inventory and Monitoring Program, and will place special emphasis on the tenets of conservation biology and ecosystem processes in the design and implementation of our management programs. Programs will also be in place for optimizing not only Federal trust species, but also biological integrity and ecosystem health in the context of refuge purposes. A variety of active and passive management programs will be deployed to accomplish habitat-based and population-based goals and objectives, including the continued extensive use of artificial nest structures, habitat creation, predator controls, active intervention to address exotic, invasive, and injurious species, and landscape-level habitat restoration.

Public Use.—Our management of public use on the island refuges will be guided by the following concepts. As with our approach at Blackwater NWR, the island refuges' public use program will promote the refuges, Refuge Complex, and Refuge System conservation messages, to help reduce the impacts on other wildlife areas and inform visitors about the importance of closed areas for wildlife. The island refuges will provide environmental education for the visiting public and training for teachers and students; develop compatible opportunities for wildlife observation, photography, hunting, and fishing; develop a friends group and volunteer program; develop extensive environmental education and interpretation facilities, programs, and activities and wildlife-dependent recreational facilities, programs, and activities to conform with "Fulfilling the Promise" and the Refuge System Administration Act. Public uses will not interfere with important nesting or wintering seasons of listed species. No public use activities will be permitted where public safety or trust resources are adversely affected.

Goals, Objectives, Strategies, and Monitoring Elements

Goal 1. Protect and enhance Service trust resources and other species and habitats of special concern.

Subgoal 1. Provide habitats to sustain 5 percent of each of Maryland's wintering waterfowl, as follows: Atlantic Population (AP) Canada goose, and dabbling duck population, as measured by the Midwinter Waterfowl Inventory.

Objective 1.1.1. On a broad scale, protect, restore, and enhance a mix of wetland habitat types throughout the island marshes by 2022.

Basis of the objective.—This objective supports the goals of the Atlantic Coast Joint Venture (ACJV), the North American Waterfowl Management Plan, 1989 Chesapeake Bay Program Waterfowl Populations Objective (as updated in 2000). The ACJV project has specifically identified Martin NWR. Under NAWMP, four priority waterfowl species associated with the island refuges benefit from the important estuarine emergent and submergent habitats: black duck, mallard, northern pintail, and blue-winged teal. Other than the midwinter waterfowl survey, standard protocols and surveys are lacking throughout the island refuges. Waterfowl law enforcement activities have been restricted to Martin NWR, and little is known about possible illegal hunting on the remaining satellites. Emergent wetland and SAV habitats are being impacted by erosion and poor water quality.

Strategies to achieve the objective.—We will initiate standard protocols and annual winter surveys throughout the island refuges by the year 2007; record habitat types for waterfowl concentration areas; incorporate them into a GIS data base; note signs of hunting and assess illegal hunting; and, determine and implement specific actions through an operational plan.

We will implement a summer water quality monitoring program following the protocols established by the "Chesapeake Bay Program Submerged Aquatic Vegetation Management Plan," and use the data collected to target SAV restoration sites and delineate areas where erosion- induced turbidity is limiting SAV resurgence. Mute swan feeding impacts to SAV beds can be assessed during water quality sampling, and specific actions determined. Mute swan control will follow the recommendations of the Mute Swan Task Force.

Management strategies in this plan include wetland creation or restoration, SAV restoration, erosion control, mute swan management, invasive plant species management (primarily *Phragmites australis*), and law enforcement. Significance of boat traffic, disturbance, and the need for a sea duck sanctuary will be assessed. Management activities for the island refuges will be more specifically addressed in the island refuges Habitat Management Plan.

Monitoring element.—Amount (number of acres) and quality (composition, structure) of available habitat and present wintering waterfowl populations. Annual water quality sampling related to suitability for SAV. Existing and planned management prescriptions will be monitored to determine vegetation and waterfowl response.

Subgoal 2. Restore, protect and enhance habitats for black duck production.

Objective 1.2.1. Create an American Black Duck Initiative for the island refuges that will include a determination of existing black duck production, the factors affecting production, and the preferred nesting and brood habitat types by 2012.

Basis of the objective.—This objective also supports the goals of the Atlantic Coast Joint Venture, the North American Waterfowl Management Plan and the 1989 Chesapeake Bay Waterfowl Management Plan (updated 2000). Although many of the islands are thought to be locally important as black duck production areas, little quantitative data is available. Predator effects at both tree hammock and emergent marsh sites requires evaluation. Predation may be causing black ducks to nest in less than optimal habitats (e.g., black needlerush) which are prone to flooding. Habitat use during brood rearing, fall migration, and winter is presently unknown.

Strategies to achieve the objective.—We will create an integrated approach to black duck research and management (Black Duck Initiative) for the island refuges. The initiative will focus research on questions regarding black duck production management. An initial strategy will be to determine black duck predator occurrence on the island refuges. Additional surveys will be conducted to determine present black duck nesting habitat use. An experimental predator removal program will be initiated to assess black duck productivity both before and after removal, and to document any changes in nesting habitat use.

Black duck habitat use during brood rearing, fall migration, and winter will be evaluated through a telemetry study. Nesting black duck females will be fitted with radio transmitters and tracked through the Summer, Fall, and Winter to determine habitat use and dispersal. In addition, experimentation with providing artificial nesting substrates in black needlerush and black duck nesting response will be undertaken.

Management strategies in this plan could involve habitat restoration or manipulation. We will evaluate converting former dredged material disposal sites dominated by Phragmites to more desirable vegetative communities to promote black duck nesting, as well as creating nesting hammocks in needlerush dominated wetlands as a management alternative. We will protect breeding habitat through erosion control.

Monitoring element.—Amount (acres) and quality (composition, structure) of preferred nesting habitat and present breeding black duck population. Management prescriptions (habitat manipulation, predator control) will be monitored to determine breeding black duck response.

Objective 1.2.2. Determine to what extent predators are limiting production of ground-nesting waterbirds by 2012.

Basis of the objective.—Preferred nesting habitat on the island refuges for ground-nesting waterbirds (e.g., black ducks, rails, and terns) occurs on the comparatively few upland hammocks scattered throughout predominately emergent wetland habitats (primarily on Martin NWR and Spring Island Satellite). Because hammocks can be easily targeted by mammalian predators such as red foxes and Norway rats, ground-nesting species may be driven into less desirable nesting habitats (e.g., black needlerush marsh). Birds forced into emergent marsh nesting then

become susceptible to egg predation by fish crows and gulls. At present little is known as to the extent of predation, significance relative to production, or which predator species are the main culprits.

Strategies to achieve the objective.—A study will be designed by 2012 to assess gull, crow, Norway rat, and red fox populations and associated predation problems. The study will use black duck and clapper rails as the study species and compare control areas vs. areas where potential predators are removed. Effects on nest site selection and nest success will be compared between control and predator removal treatment sites. The study will also employ telemetry to assess bird movements during brood rearing, fall migration, and winter. Funding for a biotechnician and graduate students is included in this plan.

Monitoring element.—Predator populations, and water bird nest site selection, production, and seasonal movements.

Subgoal 3. Restore, protect, and enhance habitats for designated species of Neotropical migrants identified for protection in the Partners In Flight Plan.

Objective 1.3.1. Determine suitable breeding habitat and population status for Henslow's sparrow, seaside sparrow, and sharptail sparrow by 2009.

Basis of the objective.—This objective generally contributes to the goals and objectives of the Region 5 priority list for the Partners In Flight Plan. Island and headland wetland habitats, particularly those occurring on Martin NWR and the Bishops Head Division, which includes Spring Island, have been identified as potential key areas for breeding Henslow's sparrow, seaside sparrow, and sharptail sparrow. Although suitable habitat occurs, present breeding use is unknown.

Strategies to achieve the objective.—The initial strategy will be to determine breeding bird distribution and habitat use on the three targeted refuge units. A baseline breeding bird survey, and subsequent annual survey will be established by the year 2009. Vegetation and hydrology data will be collected to determine preferred nesting habitat types. Data collected will be incorporated into a GIS breeding habitat mapping product. Based on data collected and a GIS assessment of existing conditions, objectives and more specific actions will be determined, and an operational plan prepared.

Management strategies in this plan could involve habitat restoration, habitat manipulation, and protecting existing habitat values. Significance of human disturbance and predation on bird production will be assessed. Protection of breeding habitat will be provided through erosion control and invasive species management (primarily *Phragmites australis*).

Monitoring element.—Amount (number of acres) and quality (composition, structure) of available habitat and present breeding bird populations. Existing and planned management prescriptions will be monitored to determine breeding bird response.

Objective 1.3.2. Provide suitable stop-over and resting habitat for Neotropical migrants and raptors on the forested islands by 2007.

Basis of the objective.—This objective also contributes to the goals and objectives of the Region 5 priority list for the Partners In Flight Plan. Martin NWR and the Watts Island and Barren Island Divisions have been identified as potential key migration and stop-over areas for migratory passerines, and raptors. In addition, large numbers of monarch butterflies are purported to use these offshore forested and shrub habitats. Although the islands are known to be used during migration, to what extent they are used is unknown.

Strategies to achieve the objective.—The initial strategy will be to determine Neotropical migrant distribution and habitat use on the three targeted refuge units. A baseline Spring and Fall Neotropical migrant survey and subsequent annual surveys will be established by the year 2009. Vegetation data will be collected to determine preferred habitat types and use by various species. Data collected will be incorporated into a GIS Neotropical migrant habitat mapping product. Based on data collected and a GIS assessment of existing conditions, objectives and more specific actions will be determined, and an operational plan prepared.

Management strategies in this plan could involve habitat restoration, habitat manipulation, and protecting existing habitat values. Significance of human disturbance will be assessed. Protection of Neotropical migrant habitat will be provided through erosion control and forest pest management.

Monitoring element.—Amount (acres) and quality (composition, structure) of available habitat and present Neotropical migrant populations. Existing and planned management prescriptions will be monitored.

Subgoal 4. Protect, enhance and create island habitats for colonial waterbirds.

Objective 1.4.1. Create 25 acres of colonial waterbird nesting habitat by 2012.

Basis of the objective.—With the exception of great blue heron and least tern, all heron and larid colonies occur on island sites. Most of the islands composing the island refuges have limited amounts of upland topography which can support vegetation suitable for shrub and tree nesting wading birds. Former dredged material disposal areas on Martin NWR exhibit elevations suitable for shrub and tree species growth, however Phragmites colonization precludes such species establishment. Many existing rookeries on Martin NWR occur on former dredged material disposal sites, which were naturally vegetated by desirable tree and shrub species before the expansion of Phragmites. More recent dredged material disposal sites have been colonized by monotypic stands of Phragmites, and do not represent nesting habitat.

Strategies to achieve the objective.—Through the use of aerial photography and interpretation, existing stands of Phragmites will be delineated and then ground-surveyed to determine suitability for tree and shrub establishment (e.g., elevations > highmarsh zone). We will use glyophosphate or another herbicide approved for estuarine applications to control Phragmites, with subsequent burning to remove dead, standing vegetation. After that, we will plant native shrub and tree species, such as hackberry, bayberry, and eastern red cedar.

Management will include preventive herbicide treatment and control around existing rookeries where Phragmites has invaded, but has not yet taken over the plant community. In addition, opportunities for creating additional tree and shrub hammocks through the beneficial use and placement of clean dredged material will be assessed. Wetland restoration and erosion control opportunities will prioritize sites where existing rookeries are in jeopardy from erosion.

Monitoring element.—Acreage and quality of shrub and hammock habitat suitable for colonial waterbird nesting.

Objective 1.4.2. Determine to what extent predators are limiting production of ground-nesting waterbirds by 2012.

Basis of the objective.—Preferred nesting habitat on the island refuges for ground-nesting waterbirds (e.g., black ducks, rails, and terns) occurs on the comparatively few upland hammocks scattered throughout predominately emergent wetland habitats (primarily on Martin NWR and Spring Island Satellite). Because hammocks can be easily targeted by mammalian predators, such as red foxes and Norway rats, ground-nesting species may be driven into less desirable nesting habitats (e.g., black needlerush marsh). Birds forced into emergent marsh nesting then become susceptible to egg predation by fish crows and gulls. At present, little is known about the extent of predation, its significance to production, or which species are the main predators.

Strategies to achieve the objective.—A study will be designed by 2012 to assess gull, crow, Norway rat, and red fox populations and associated predation problems. The study will use black duck and clapper rails as the study species and compare control areas to areas where potential predators have been removed. The effects on nest site selection and nest success will be compared between control and predator removal treatment sites. The study will also employ telemetry to assess bird movements during brood rearing, fall migration, and winter. This plan includes funding for a biotechnician and graduate students.

Monitoring element.—Predator populations, and water bird nest site selection, production, and seasonal movements.

Subgoal 5. Provide habitats to support a diversity of migrating and nesting shorebirds, gulls, terns and allied species.

Objective 1.5.1. Protect, enhance and create foraging and nesting habitat for a diversity of migrating shorebirds, gulls, terns and allied species by 2014.

Basis of the objective.—The island refuges' habitats primarily comprise emergent estuarine wetlands, SAV beds, and upland shrubs and forest. Shorebird use, either for nesting or foraging, is concentrated in the less prevalent intertidal flats, beach, and bay dune habitats that fringe the islands. Many of these shorebird areas are being impacted by erosion, and as much as 50 feet a year of beach habitat is being lost.

Maryland DNR has an existing shorebird banding and brown pelican color marking program which includes colonies on the island refuges. This program needs to be expanded, with the Service taking a more active role.

Strategies to achieve the objective.—The USACOE maintains boating channels close to the island refuges. Maintenance dredging for navigation purposes often generates sandy dredged material suitable for intertidal flat, dune, and beach creation. Given the lack of suitable upland disposal sites in this portion of Chesapeake Bay, there is an opportunity to provide placement sites for purposes of shorebird habitat restoration.

The management strategy in this plan will be to designate sites for beneficial uses of dredged material aimed at shorebird habitat creation or restoration. This can be done in conjunction with sites that are prioritized for erosion control. Habitat restoration will be funded through the USACOE, in consultation with the refuge. Habitats to be created will benefit other species such as nesting diamondback terrapins.

In addition to habitat restoration, this plan includes generating funding to hire a biologist to work with the Maryland DNR banding and color marking program. Additional responsibilities of this position will include monitoring of these and other restoration programs on the refuge.

Monitoring element.—Shorebird population dynamics and distribution, fish and wildlife use, vegetation response, dredged material movement and topography changes over time, and invasive plant management.

Subgoal 6. Provide habitats to support estuarine habitat associated raptors.

Objective 1.6.1. Evaluate the efficacy of the artificial nesting program for raptors by 2010.

Basis of the objective.—Martin NWR, Spring Island, and Watts Island have played a pivotal role in the recovery of the formerly listed peregrine falcon (endangered), delisted in 1999. Four artificial nesting structures have fledged 56 peregrine falcons since 1986. Scientists involved in peregrine recovery have questioned the continued construction of peregrine nesting structures anywhere on the Delmarva peninsula. Translocations now are restricted to the Maryland and Virginia Piedmont, which, unlike Delmarva, are considered the species' former range.

Osprey populations plummeted in the 1950s due to eggshell thinning associated with the uptake of the pesticide DDT. Following the ban on DDT, osprey populations throughout Chesapeake Bay dramatically rebounded. Although natural nesting sites are limited on some of the refuges and divisions of the Refuge Complex and on Spring Island, this is not the case for most of the refuge or the watershed.

The installation and maintenance of osprey nesting platforms at Martin NWR has created the region's largest concentration of nesting osprey. Since 1980, the osprey have produced 850 fledglings. Ospreys readily use other structures: for example, channel marks or towers. Barn owls are another species of concern in Maryland that readily uses artificial nesting structures.

Strategies to achieve the objective.—We will maintain the existing peregrine falcon and osprey nesting structures on Martin NWR, Spring Island, and Watts Island; evaluate the existing natural nesting habitat on the other islands and determine whether an expansion of the artificial nesting structure program is justified in view of expanding osprey

populations; evaluate whether to expand or simply maintain the peregrine falcon nesting structure program; and, evaluate the need for artificial structures for barn owls.

Monitoring element.—The population trends of ospreys, peregrine falcons, and owls within the range of the island refuges.

Subgoal 7. Accomplish applicable recovery objectives for Federal-listed species as outlined in recovery plans.

Objective 1.7.1. Conduct surveys and evaluate the feasibility of reestablishing a northeastern beach tiger beetle population by 2012.

Basis of the objective.—The northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) occurred historically in great swarms on beaches along the Atlantic Coast, from Cape Cod to central New Jersey, and along Chesapeake Bay beaches in Maryland and Virginia. Only two small populations remain on the Atlantic Coast. The subspecies occurs at more than 50 sites in the Chesapeake Bay region.

The tiger beetle is most vulnerable to disturbance in the larval stage, which lasts 2 years. Larvae live in vertical burrows, generally in the beach intertidal zone, where they are sensitive to destruction by high levels of pedestrian traffic, ORVs, and erosion control projects that allow the beach to become vegetated. Population recruitment seems to be hampered by a lack of both undisturbed beaches and of nearby populations as a colonizing source. Although suitable habitat appears to be available on Martin NWR and Watts Island, the occurrence of tiger beetles is unknown.

Strategies to achieve the objective.—The initial strategy will be to have all the islands with suitable habitat surveyed for tiger beetles; contracting university experts to conduct the survey will be necessary. If tiger beetles are found, we will implement management actions under the guidelines of the "Northeastern Beach Tiger Beetle Recovery Plan" (USFWS 1994), working with the Tiger Beetle Recovery Team. An opportunity may arise to create new tiger beetle habitat using sand generated by USACOE dredging projects in the vicinity of the islands. We will also assess the potential for translocating tiger beetles to natural and created beaches.

Monitoring element.—Monitor known populations and any additional populations that are discovered; evaluate human impacts.

Objective 1.7.2. Protect, manage, and conserve the existing bald eagle population by 2007.

Basis of the objective.—The bald eagle population in Chesapeake Bay has been Federal-listed as endangered since 1978. Eagle nesting occurs on Smith, Watts, and Barren Islands, and has been continuous on the islands in recent years. This success has been the result of protecting nests from human disturbance during the nesting season.

Strategies to achieve the objective.—We will continue to implement the guidelines in the "Bald Eagle Recovery Plan" (USFWS 1990). Regardless of the proposed delisting of the bald eagle, management at the island refuges will continue to focus on maintaining the existing eagle nesting sites and protecting them from disturbance.

Monitoring element.—The number of nesting bald eagles as determined by aerial surveys.

Subgoal 8. Restore, protect and enhance habitats for anadromous and interjurisdictional fish species.

Objective 1.8.1. Inventory anadromous and estuarine and inland interjurisdictional fisheries on the island refuges by 2012.

Basis of the objective.—The marshes of the islands are permeated with tidal creeks, which provide spawning, or feeding habitat for an abundance of finfish. The adjacent shallow and deeper waters support an extensive fishery stock, and commercial fishing industry. This productivity, in large part, is related to the extensive SAV beds associated with the island refuges. However, many colonial waterbirds nesting on the islands travel daily to the mainland for feeding. Why the birds elect to travel to the mainland, or whether forage fish stocks are less plentiful on and around the islands, is unknown.

Strategies to achieve the objective.—Our initial strategy will be to design jointly with our Fisheries Resources Office an inventory or study that will compare the waterbird forage base on mainland sites with island sites, in conformance with the Complex-wide Resource Inventory and Monitoring Plan. Using the study's findings, we will define more specific actions regarding fish habitat management on and around the island refuges; and, implement the recommendations of the "Submerged Aquatic Vegetation Policy for the Chesapeake Bay and Tidal Tributaries" (Chesapeake Bay Program). Goal 2, below, covers SAV policy recommendations in more detail.

Monitoring element.—Approval of inventory plan.

Subgoal 9. Restore, protect, and enhance habitats for blue crab.

Objective 1.9.1. Where applicable, implement recommendations of the 1997 Chesapeake Bay Blue Crab Fisheries Management Plan by 2007.

Basis of the objective.—Tangier Sound is one of the most important soft-crab- and peeler-crab-producing areas in the Chesapeake Bay. The brackish waters associated with the island refuges exhibit this high production because of the extensive SAV beds within the interior tidal guts and surrounding shallow waters. Blue crabs (*Callinectes sapidius*) use the SAV beds during postlarval settlement, juvenile development, overwintering, and for protection during molting and soft shell phases of all size classes. In Tangier Sound SAV beds are composed of eel grass (*Zostera marina*) and widgeon grass (*Ruppia maritima*), and fall within the salinity range of invading postlarvae. Juvenile crab density is approximately 30 crabs per square meter in SAV, as compared to only one crab per square meter in unvegetated habitat.

Strategies to achieve the objective.—The SAV Workgroup of the Chesapeake Bay Program Living Resources Subcommittee recommended strategies for SAV protection and restoration to benefit blue crab postlarval settlement. The recommendations apply to the segment of the Chesapeake Bay that includes Tangier Sound. The island refuges will implement recommendations of the Chesapeake Bay Program Submerged Aquatic Vegetation Policy for the Chesapeake Bay and Tidal Tributaries. Goal 2, below, covers specific recommendations included in this policy.

Monitoring element.—Water quality parameters that will result in the restoration of SAV.

Goal 2. Maintain a healthy and diverse ecosystem with a full range of natural processes, natural community types, and the full spectrum of native plants and animals to pass on to future generations of Americans.

Subgoal 1. Control, eradicate, or manage injurious, invasive, and exotic species.

Objective 2.1.1. Eradicate the mute swan population on the island refuges by 2007.

Basis of the objective.—Mute swans are exotic, non-migratory birds that escaped into the Chesapeake Bay in 1962, and have reached an estimated population of 4,000. They are protected under Federal and State laws. On the island refuges, they are injurious to SAV and, because of their aggressive territorial behavior, displace nesting native colonial waterbirds. In 1993, mute swans destroyed the only black skimmer colony in the Chesapeake Bay and the State-listed least tern colony on Barren Island.

Strategies to achieve the objective.—The refuge will continue to participate on the Maryland Governor's Task Force on Mute Swan Management, and will support the mute swan management actions endorsed by the Atlantic Flyway Council, including:

1. State and provincial wildlife agencies, if they do not already have authority, should seek to gain authority over the sale and possession of mute swans and their eggs.

2. The sale of mute swan adults, young, or their eggs should be prohibited.

3. States should seek to eliminate all importing or exporting of mute swans without a special purpose permit issued by the state wildlife agency.

4. Mute swans captured due to nuisance complaints, sickness, or injury should be removed from the wild or be euthanized.

5. Egg addling programs, where feasible, should be encouraged.

6. Both state and Federal wildlife agencies should institute programs to prevent the establishment of or eliminate mute swans.

7. States and provinces should seek to make the mute swan an unprotected species if this is not already the case.

8. States should strive to manage mute swan populations at levels that will have minimal impacts on native wildlife species or habitats.

The island refuges have zero tolerance for mute swans, and will take appropriate actions to keep swans from becoming established on refuge lands. However, refuge staff do not control swans on State-owned waters.

Monitoring element.—Aerial surveys to determine overall and nesting distribution.

Objective 2.1.2. Reduce Phragmites below year 2000 levels by 2012.

Basis of the objective.—Phragmites (*Phragmites australis*) is a large, coarse perennial grass 1.5–4 m in height. While primarily found in brackish and freshwater wetlands where it grows at and above mean high water, the plant is also common in moist uplands and the dune systems of Atlantic coast barrier islands. Phragmites seeds profusely and spreads vegetatively by a vigorous system of rhizomes and stolons. Once established, the plant forms dense stands and may invade adjacent areas, crowding out more desirable wetland species and reducing the overall species diversity of the affected system. Some question whether phragmites is native, or whether a native and a more invasive exotic genotype exists. Phragmites often establishes itself in areas modified by human activity. A particular problem is its colonizing dredged spoil disposal areas.

Strategies to achieve the objective.—The primary strategy will follow management prescriptions recommended for creating colonial waterbird nesting habitat (goal 1, subgoal 4, objective 1). Where funding allows, we will also delineate, target, and control other areas where Phragmites occurs.
Monitoring element.—Phragmites distribution and trends

Subgoal 2. Protect, enhance, and restore natural diversity of communities and associated ecosystem processes on the island refuges.

Objective 2.2.1. By 2012, develop specific inventory, assessment, and management programs for species and community types identified as rare, sensitive, declining, or of special concern.

Basis of the objective.—The island refuges have a clear mandate to protect, manage, and restore habitats that support Federal- and State-listed rare or threatened species, and species of special concern. At present, we know very little about the occurrence of such species on the island refuges.

Strategies to achieve the objective.—Our most important need is to develop and implement the Complex-wide Resource Inventory and Monitoring Program. We will contract with experts at the Heritage Program, USGS–BRD, or universities for surveys for listed species and species which are uniquely difficult to detect. We will implement appropriate tasks identified in existing recovery plans for Federal- and State-listed species. With the development of the Forest Management Plan and the Marshland Management Plan, opportunities will exist to evaluate the effects of management practices (e.g., TSI, prescribed fire) on species of concern.

Monitoring element.—Species diversity indices; species richness

Objective 2.2.2. Control erosion, and create and restore habitat, through the beneficial use of clean dredged material by 2007.

Basis of the objective.—The islands of the Chesapeake Bay constitute a unique ecosystem component that is rapidly being lost to erosion. New islands are not being formed due to the armoring of mainland shorelines, and the sediment loads generated are negatively affecting SAV. Shallow waters that formerly were island marsh and forest are characterized by a hard, laminar, mud clay bottom. Such bottom types do not support SAV, and support a comparatively depauparate benthic community. Targeting former fastland areas converted to shallow water minimizes resource tradeoffs associated with filling for wetland, beach, and upland restoration. Restored habitats can be constructed in such a fashion that benefits erosion control, while reducing sediment loads and turbidity.

Strategies to achieve the objective.—Using GIS, we will delineate and prioritize the most severely eroding shorelines. Then, we will assess boating channels near the island refuges for the feasibility or desirability of dredging and using the clean dredged material in other erosion control projects. Factors will include baseline conditions, habitat tradeoffs, grain size analysis, contaminants assessment, and distance from priority erosion control sites. In this plan, we will keep the Susquehanna NWR within the Refuge System, and target it for habitat restoration using clean dredged material.

Throughout project planning, we will coordinate closely with the Baltimore and Norfolk Districts, USACOE, to ensure this approach to the beneficial use of dredged material meets the dual objectives of habitat restoration and navigability. We will specifically refer to the USACOE's May 2005 Baltimore Harbor and Channels, Dredged Material Management Plan and Draft Tiered Environmental Impact Statement, which documents the regional benefits of using dredged material from the mainstem channels for marsh restoration in Dorchester County (USACOE 2005). Habitat restoration project types (e.g., wetland, upland, or beach) will be determined by existing site conditions, fetch, habitat tradeoffs, and resource priority. For example, if restoring the northeastern beach tiger beetle were the priority, erosion control will be minimal, in order to maintain or create an unvegetated beach to benefit the beetle. Where erosion control is the highest priority, we will focus on wetland restoration, in conjunction with offshore, segmented stone breakwaters.

In addition to restoring habitat, this plan includes generating funding to hire a biologist, who will work in close coordination with the Corps, and to hire a biotechnician for monitoring plant, animal, and water quality responses. SAV restoration targeting will be a closely related priority.

Monitoring element.—Habitat response, topography (vertical and horizontal), fish and wildlife use, water quality improvements, SAV distributional changes, and acres restored.

Subgoal 3. Protect, restore, and enhance SAV habitats.

Objective 2.3.1. Restore SAV coverage to 1970s levels by 2022.

Basis of the objective.—Waters within and surrounding the island refuges support 16 percent of all SAV within the tidal portion of the Chesapeake. Although 13 principal species are distributed around the Bay, two are prevalent in the "Crabbing Capitol of the World": eel grass (*Zostera marine*) and widgeon grass (*Ruppia maritima*). Widgeon grass grows in the shallowest water zone (< 3' MLW) and eel grass grows in the deeper shallow zone (3–6" MLW). Both species' water depth tolerances have been reduced by declines in water quality and subsequent reduction in the photic zone.

The Chesapeake Bay Program has targeted SAV as one of its highest priority living resources, because of the many ecological functions it serves: It provides shelter and nursery area for fish, crabs, invertebrates, and epiphytes; it has long been recognized as an essential food for certain waterfowl species; it removes nutrients and heavy metals from the water and sediment, removes suspended sediment and binds substrates; and, in dense beds, it dissipates wave energy and protects shorelines from erosion. SAV is also a barometer on the health of the Chesapeake Bay because its environmental requirements include good water quality that is low in suspended sediments, dissolved nutrients, and phytoplankton. For these reasons, the recent decline in SAV throughout the island refuges is alarming.

Strategies to achieve the objective.—We will implement the recommendations of the Chesapeake Bay Program Submerged Aquatic Vegetation Policy for the Chesapeake Bay and Tidal Tributaries (1989). These include

- Protecting existing SAV beds from further losses due to increased degradation of water quality, physical damage to the plants, or negative disruption to the local sedimentary environment
- Setting and achieving regional water and habitat quality objectives that will result in the restoration of SAV through natural revegetation;
- Setting regional SAV restoration goals in terms of acreage, abundance, and species diversity considering historical distribution records and estimates of potential habitat.

Island refuges strategies can support these recommendations through erosion control and habitat restoration aimed at biodiversity (see goal 2, subgoal 2, objective 2, "Erosion Control and Beneficial Use of Dredged Material"). These strategies will decrease sediment loadings associated with island erosion. Maintaining adequate depths in boating channels decreases the likelihood of resuspension of channel bottom material by boat wakes and propellor wash. We will provide the USACOE with placement locations (presently in short supply) so channels can be dredged on schedule.

In other areas around the island refuges, fetch and wave energy may be the limiting factor for SAV recolonization. Again, working with the COE in looking at historical land mass and SAV records, we will delineate formerly quiescent shallow waters now exposed to higher wave energies. Those sites will not have a wetland, upland, or beach habitat restoration component, and could be prioritized for offshore breakwater construction by the COE. Breakwaters will be constructed to recreate quiescent shallow waters where they historically occurred. We will monitor wave energies, sediment changes, and SAV response before and after construction.

This plan also includes a water quality and SAV monitoring initiative to characterize baseline conditions and future SAV response to all management actions, and includes funding to hire a biotechnician for data collection and analysis. Water quality and SAV monitoring will follow the protocols of the Chesapeake Bay Program SAV Workgroup.

Monitoring element.—Water quality, sediment types, wave energy, bathymetry, and SAV distribution.

Goal 3. Create the most complete network of protected lands within the Chesapeake Bay watershed.

Objective 3.1. Implement strategies for the protection of the island refuges by 2022.

Basis of the objective.—Federal management of additional land on the islands will contribute to the resource conservation goals of a variety of international, national, and regional initiatives, including RAMSAR, IBA, NAWMP, and the "National Wetlands Priority Conservation Plan." Management also supports objectives of the Chesapeake Bay Program Living Resources Subcommittee under specific workgroup recommendations for SAV, wetlands, waterfowl, and blue crab. Protecting land on the islands will also benefit private landowners on the mainland by preserving the barrier function of offshore islands.

Strategies to achieve the objective.—We will seek all opportunities to conserve, manage, and protect lands through a combination of easements, forging partnerships with landowners, and developing agreements with other entities having title and other land rights or interests in targeted areas of the watershed by 2022.

- Amend the 2005 appropriations bill for the Department of Defense to include wording that transfers Bloodsworth Island to the Service, should the Navy declare it excess real property.
- Secure management authority of South Marsh Island through a Cooperative Agreement or Memorandum of Understanding with the MD Department of Natural Resources, if amenable.
- Assist partners, including the states and the Chesapeake Bay Foundation, Inc., in developing an island protection plan as part of an ecosystem component.

- Acquire inholdings as they become available from willing sellers.

Monitoring element.—The implementation of the Resource Inventory and Monitoring Plan; and, the acquisition and maintenance of remote sensing or GIS layers.

Goal 4. Develop and implement quality scientific research, environmental education, and wildlife-dependent recreation programs that raise public awareness and are compatible with refuge purposes.

Subgoal 1. Encourage and provide opportunities for research by other agencies, universities, and other institutions, especially as they relate to the mission, management, and objectives of the island refuges.

Objective 4.1.1. Foster relationships with governmental entities, conservation groups, universities, and institutions and communicate the most critical research and management needs of the island refuges by 2009.

Basis of the objective.—Service policy encourages and supports research and management studies that provide data for making decisions on managing the island refuges. Research and monitoring are crucial to sound resource decisions and adaptive management.

Strategies to achieve the objective.—We will actively seek partnership opportunities, and will consider proposals for research in a variety of disciplines, including flora and fauna, public use, and cultural resources. All reports, surveys, and scientific papers generated will be made available to refuge staff and cataloged for future needs. The refuge will communicate and prioritize information gaps we seek to fill. Priority will be given to studies that contribute to the enhancement protection, use, preservation, and management of native fish and wildlife populations and their habitats and natural diversity. In addition to fish- and wildlife-oriented research, we will permit the use of island refuges lands for other investigatory scientific purposes when such use is compatible with the purposes, goals, and objectives of the refuges.

Monitoring element.—The number of partnership initiatives; the number of research projects; and the number of participants in each.

Objective 4.1.2. Provide adequate facilities and equipment and assess the need for building new facilities for use by researchers and refuge staff.

Basis of the objective.—The Middleton House on Martin NWR is the only facility now available to house researchers or as a base of operation for refuge staff. The existing structure is cramped, outdated, poorly insulated, and in need of new plumbing. The house also serves as a small visitor center. Better facilities and equipment will improve research, housing, and headquarters for the island refuges. Given the isolated location of Martin NWR, a self-sufficient research facility and base of operations is required for Service research and management activities.

Strategies to achieve the objective.—Renovate and enlarge the Middleton House and purchase new equipment to accommodate researchers, students, and refuge staff.

Monitoring element.—Adequacy of facilities and equipment.

Subgoal 2. Provide opportunities for environmental education and interpretation to meet the needs of refuge users.

Objective 4.2.1. By 2012, develop adequate facilities and equipment for environmental study and interpretation for the island refuges.

Basis of the objective.—The Middleton House, the current facility on Martin NWR, is woefully inadequate. No staff are available for environmental interpretation, and the few existing displays fail to capitalize on the human inhabitants' unique island culture, fishing and crabbing industry, or the islands' crucial role in Chesapeake Bay

ecology. An opportunity exists for the refuge to become a major destination for tourists visiting Smith Island. With an adequate facility, the refuge potentially could attract 60,000 refuge visitors per year. Siting a facility in the town of Ewell will ensure compatible use, and provide habitat restoration education possibilities.

Strategies to achieve the objective.—We will upgrade the visitor contact station at the Middleton House on Smith Island to provide new displays and material on the island refuges; provide office space with telephone, fax machine, computer, and copy machine; provide suitable furniture for second-floor lodging of interns and researchers; and upgrade plumbing and electrical systems. We will also increase environmental education and interpretation activities.

In the town of Ewell, we will purchase suitable land near the Middleton House to build and manage an environmental education center that highlights island refuges ecology in partnership with the Chesapeake Bay Foundation, Inc. We will also build a kiosk at the Ewell ferry dock to provide directions and interpretive information, and develop exhibits and habitat restoration projects for the Middleton House and environmental education center.

Monitoring element.—The number, type, and location of facilities and programs; the response by refuge visitors (the number and types of visitors or groups).

Objective 4.2.2. By 2007, provide interpretation programs to enhance visitors' knowledge of the island refuges and refuge management, while providing an enjoyable refuge experience.

Basis of the objective.—Refuges provide opportunities for people to acquaint themselves with the Service and its range of activities at first hand. More importantly, through interpretation programs, facilities, and guided public use strategies, the Refuge System helps people understand their place in the environment. No staffing or programs currently exist for the island refuges to provide interpretation programs. Although staff from the Refuge Complex or Blackwater NWR could implement some of these programs, we need to create specific programs targeting the island refuges if the refuges are to achieve their education and recreation goals.

Strategies to achieve the objective.—We will develop a professional video on the island refuges and purchase other videos that apply to the refuges for use in the visitor center; develop a general leaflet and other self-guided leaflets and brochures; install signs where needed; develop additional new outdoor displays; develop at least one special event for the islands, and participate in Crisfield events; create a website and interactive computer information station..

We will hire an Outdoor Recreation Planner to provide the increased public use program activities, supervise interns, and conduct public education, interpretation, and outreach programs for the island refuges. We will develop a volunteer program for monitoring, education and interpretation programs, outreach, and maintenance at the island refuges; develop a friends group to create a small cooperative sales outlet for Federal passes, educational books and other items; seek funding, develop programs; and produce projects.

We will expand our outreach programs to reach an additional 15,000 visitors by incorporating summer programs that coincide with tour boats visiting the island refuges; develop an MOU with the Chesapeake Bay Foundation, Inc., to work together on environmental education and interpretation programs and events; develop an interpretive sea kayak trail among the islands, if compatible with refuge purposes. Upon completing a compatibility determination, we will develop an interpretive canoe or kayak trail on Martin NWR; and, provide guided interpretive estuarine tours for education groups during the spring and fall.

Monitoring element.—The number, type, and location of facilities or activities, and response by refuge visitors (the number and type of visitors or groups using each facility, location, or activity).

Subgoal 3. Provide opportunities for compatible wildlife-dependent recreation.

Basis of the subgoal.—The NWRSIA identifies six priority wildlife-dependent recreational uses the Service must facilitate in the Refuge System: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. By providing the public with opportunities for those uses, we will increase public

awareness, understanding, and appreciation of ecosystem functions and the benefits of ecosystem conservation to fish, wildlife, and people. Ultimately, these will contribute to the mission of the Refuge System.

Objective 4.3.1. By 2009 provide opportunities for wildlife observation and photography

Basis of the objective.—During our scoping meetings, the public indicated its interest in having opportunities and facilities for wildlife observation and photography. Achieving this objective will provide the public an opportunity to view the relationships among resource management, living resources, and people.

Strategies to achieve the objective.—We will construct a wildlife observation trail or boardwalk on Martin NWR associated with the new environmental education center. The resources profiled will include waterfowl, water birds, and saltmarsh ecology. We will also build an observation tower and observation and photography blinds in suitable locations, and install a spotting scope. In cooperation with partners, we will conduct a needs assessment to determine the scope, extent, and compatibility of additional facilities and programs.

Monitoring element.—The number, type, location, and response of refuge visitors user hours.

Objective 4.3.2. Provide safe and adequate fishing facilities and opportunities.

Basis of the objective.—The island refuges do not have jurisdiction over the shallow water interior to the islands, or shallow and deep waters surrounding the islands. The Service is not authorized to regulate fishing or other waterborne activities within the navigable waters of the State, or within areas where water bottoms are State-owned. Public access to fishing is by boat only, and people can fish anywhere, provided they have a boat. Given the vastness and complexity of the wetlands and waterways around Martin NWR, we consider boat rentals a safety concern for the inexperienced boating public. Therefore, we propose no additional measures.

Objective 4.3.3. By 2008, provide opportunities for a high quality hunting program.

Basis of the objective.—Recognizing hunting as a traditional family-oriented form of recreation important in developing an appreciation of fish and wildlife, the public requested expanded hunting opportunities during our scoping meetings. Hunting currently is not allowed on any of the refuge islands, nor are we proposing to open any existing Service-owned island lands to hunting. However, should the Maryland DNR enter into an MOU with the Service for its management on South Marsh Island, existing state hunting opportunities and access will be maintained. The MOU will not require a compatibility determination for an existing state use.

Monitoring element.—The number and type of hunting experiences, and response of refuge visitors (number and type of visitors or groups participating in each hunt).

Subgoal 4. Protect human health and safety.

Objective 4.4.1. Ensure that human health and safety are primary considerations in implementing refuge management activities.

Strategies to achieve the objective - Allowed public uses and many refuge management activities have undergone a compatibility determination that considers human health and safety prior to implementation.
One refuge management activity affecting public health and safety that relates to both our wildlife habitat and public use programs is mosquito control. In rare circumstances mosquitoes can serve as disease vectors presenting a threat to human health. West Nile virus and encephalitis are two examples of mosquito borne diseases that are a public health concern. It is the policy of the National Wildlife Refuge System that we will allow native mosquito populations to function unimpeded and we may allow mosquito populations to be controlled only in the following circumstances:

1. There is a need to manage a public or wildlife health threat from a specific mosquito-borne disease that mosquito and disease monitoring data, collected by either the Service or state/local public health or mosquito control agencies, have documented as enumerated in Service policy.

2. There are tires, tanks, or other similar debris/containers that may serve as artificial breeding sites for native or non-native species of mosquitoes. We may remove these or treat them with pesticides.

3. We are enhancing, restoring, or managing habitat for other wildlife species to achieve refuge purposes. This may be in the form of habitat restoration or water level manipulations where there is a definable benefit to other wildlife over not undertaking such actions. We prohibit habitat modifications or management actions designed specifically for mosquito control that impact other wildlife species or habitats and are detrimental to refuge purposes or System goals. These modifications or actions include, but not limited to, inappropriate draining, maintaining high water levels that are inappropriate for wildlife, and the importing or enhancing of non-native predators.

4. There is a need to manage a threat to public health and safety from extreme numbers of biting mosquitoes when advised to do so by the Centers for Disease Control and Prevention (CDC) and/or the Federal Emergency Management Agency (FEMA). Such mosquito control may be necessary following natural or human-caused disasters when biting mosquitoes may hamper recovery efforts.

In cases of officially determined health emergencies, any method we use to manage mosquito populations within the refuge will conform to applicable Federal laws such as the Endangered Species Act. Habitat management and pesticide uses for mosquito control will give full consideration to the integrity of non-target populations and communities. They will also be consistent with integrated pest management strategies and with existing pest management policies of the Department of the Interior and the Service.

Goal 5. Ensure that the staffing, facilities, resource protection, and infrastructure necessary for plan implementation are developed.

Objective 5.5.1. By 2007, obtain base funding necessary to fund and maintain minimum staffing, facilities, and operational support of the island refuges.

Basis of the objective.—Only two full-time equivalencies (FTEs) are now funded for the island refuges. The Refuge Complex staffing chart (see appendix D) identifies the minimum staffing level for these refuges. Staff are needed for basic resource inventorying and monitoring, and to ensure the use of the best science for management decisions. Additional biological and maintenance staff are needed to maintain intact and diverse ecosystems, recover endangered species, and to combat the effects of sea-level rise, land subsidence, and invasive species. Law enforcement officers are necessary to ensure the safety of visitors and resource protection. Critical needs exist in the public use programs to respond to expected high levels of visitation and the demand for opportunities for visitors to experience and appreciate wildlife. Existing equipment inventories are not sufficient to provide effective support to existing or additional staff.

This plan will require staff to effectively perform all identified public use, management, inventory, enforcement, and maintenance programs. The existing staff, equipment, and infrastructure for the Refuge Complex cannot manage the additional workload.

Strategies to achieve the objective.—We will obtain congressional, national, and regional support for base funding for approved RONS projects; obtain local community support for implementing programs, including expanding use of volunteers, partners, and interns to accomplish programs and projects; and, seek opportunities for collaborative funding projects.

Monitoring element.—The number of permanent full-time staff.

Management Summaries

A. Biological Diversity, Biological Integrity, and Environmental Health Management

Background

Biological diversity, or "biodiversity," a term much used in conservation science and academic circles, results from the ways in which biological entities, e.g., animals, plants, or humans, interact with their physical environment.[8] We can refer to that interaction as an ecological system, or "ecosystem," which we can define on many different scales: the Chesapeake Bay watershed, the Nanticoke River, or even a vacant lot or small patch of habitat within a residential development. The important point here is that biodiversity is a collection of life occupying a slice of space and time that is dynamic, that intermingles among its members, that is subject to external forces, that may or may not be in balance, that is sometimes affected by natural disturbances, and that reacts to or incorporates humans and their direct or indirect effects.

Another essential point is that Service management programs occur in a fragmented and highly manipulated environment. Human society has removed natural areas or has altered them substantially on the landscape. Small patches of wildlife habitat often occur in areas dominated by agricultural fields, dammed rivers, highways, and residential and commercial developments. Practicing effective conservation in altered landscapes, as on the Eastern Shore, embodies two major precepts.

1. It necessitates shifting management from a strictly hands-off approach to one that considers the need for various interventions, and suggests the need for careful assessment of the dynamic outcomes of that intervention. Interventions will be designed to enhance, or in some cases, restore, the integrity and health of animal and plant populations or natural processes that are absent or have become disrupted due to the effects of habitat loss or fragmentation, pollution, or competition from invasive, injurious and overabundant species.

2. It necessitates recognizing that not all species or processes require human intervention or special management emphasis. Many species of plants and animals and many physical processes sustain themselves regardless of human influences. Many plants and animals actually take advantage of those influences. We call them "weeds," or "exotic, invasive, or overabundant species." Other native species, however, are experiencing declines due to their extremely specific life history requirements for breeding, feeding, and sheltering habitats, or the disruption of the ecosystem processes that sustain them.

Through public participation, consultations with experts, literature review, and other internal and external deliberations, we have identified assemblages of species, plant communities, and processes that we believe have the most immediate management needs. The decision whether to take management actions must also evaluate their expected effects on the identified goals, objectives, and strategies necessary to fulfill the primary purpose(s) for which each refuge within the Refuge Complex was established. We believe that our management programs will achieve biological integrity and diversity and environmental health, will maintain refuge purposes, and will support the relevant policies in the Fish and Wildlife Service Manual [601 FW 3].

Programs to benefit biological integrity, biological diversity, and environmental health are ongoing. The refuge's current management produces collateral benefits to other species and to ecosystem processes. For example, managing invasive, injurious, or overabundant species will also address a significant indirect cause of many rare, declining, or otherwise sensitive species' habitat loss. Similarly, intensively managing wetlands and water management systems will result in some hydrological restoration, and will also support the life history requirements of many wildlife species, some of them sensitive, rare, or declining, which are not identified as Service trust resources.

[8] Biodiversity Communications Handbook 2000

First, we used the classification systems employed by The Nature Conservancy to establish the relative imperilment or vulnerability of species or communities that the public had identified during our scoping and partnership meetings. Our threshold was a global rank of G3 or higher, that is, G1, G2, or G3.[9] Then, we identified marshes and forests requiring more specific attention in the form of step-down plans, and assigned those habitats the highest priorities for allocating Refuge Complex administrative, technical, and financial resources.

Our management plan will develop a baseline inventory program for the entire Refuge Complex and, subsequently, develop programs to conserve, protect, or enhance rare, sensitive, or declining species or communities or those of special concern. We will assess their integrity and health, and identify their special needs for immediate management actions. Once we have collected that information, we will incorporate those special needs into our management and operational infrastructure, developing partnerships with outside groups for issues that extend beyond Refuge Complex boundaries. This plan assumes the funding and staffing capacity to carry out these management programs and activities. Without sufficient personnel and resources, meeting the objectives for each refuge of the Refuge Complex will be problematic.

B. Marsh Management

Background

The Refuge Complex encompasses more than a third of the Chesapeake Bay tidal marshlands in Maryland. Their significance to the ecosystem cannot be overstated. Almost 50,000 acres of brackish high marsh support 6 percent of Maryland's wintering waterfowl population, the largest breeding population of American black ducks south of Maine, the largest nesting population of bald eagles on the Atlantic Coast north of Florida, the second most significant nursery for blue crab larvae in the Chesapeake Bay, both nursery and spawning habitat for eight species of anadromous and nine species of migratory intercoastal and estuarine inland interjurisdictional fish, 16 percent of the SAV beds remaining in the Bay, and the northernmost expanse of Olney three-square (*Schoenoplectus americanus*). Brackish marshes on and around Blackwater NWR have been the source for several rare populations in Maryland, including the black rail (*Laterallus jamaicensis*), coastal plain swamp sparrow *(Melospiza georgiana nigrescens*), and the rare skipper (*Problema bulenta*). All of these superlatives contributed to the designation of the marshlands within the Refuge Complex as a Wetland of International Importance by the Ramsar Convention in 1987, one of only 18 such sites in the United States (see chapters 1 and 3).

However, since its establishment in 1933, Blackwater NWR has lost nearly 7,000 acres of wetlands, primarily in the mesohaline Olney three-square marsh at the confluence of the Little Blackwater and Blackwater rivers, but also progressively downstream. Several scientific studies since the 1970s have focused on this unusually high rate of wetland loss, which may result from several compounding factors including sea-level rise, land subsidence, saltwater intrusion, severely modified hydrology, and excessive herbivory. Similarly, the Nanticoke estuary has lost 122 acres of marsh annually over the same time interval; unlike the Blackwater system, much of this loss has occurred in submerged upland marshes, with rates increasing down the estuary (Kearney, et al. 1988).

Marsh loss of this magnitude is clearly a concern for the Refuge Complex, not only because of the substantial loss of wetland acres, but also because its mandate to provide habitats for waterfowl and threatened or endangered species is compromised. As one of the largest Federally owned systems of lands and waters in the Chesapeake Bay ecosystem, the Refuge Complex has the potential to play a pivotal role in fulfilling goals of the Chesapeake Bay Watershed Partnership, the Atlantic Coast Joint Venture, and Partners In Flight. Although the issue is very real, its solutions are not as apparent, because we lack an understanding of how its factors, many of them external to the refuge, interact. Finding a long-term set of solutions to this problem also demands a response to the overriding concern of how saline Blackwater's estuarine system should be allowed to become over time. The Blackwater River apparently changed from nontidal freshwater to tidal freshwater about 4,000 years ago (Rizzo 1995), and has continued to progress toward a more mesohaline condition.

[9] For complete information, see chapter 3, "Affected Environment."

A comprehensive marsh management plan will involve more active nutria control, prescribed burns, erosion control, the use of dredged material to raise marsh elevation, shoreline protection, and the restoration of key hydrological processes.
Because seawater is predicted to inundate most of the existing refuge lands by the next century, we considered working with, rather than against, these geomorphological processes. That approach will call for protecting the shoreline of uplands, improving the drainage of marshlands to flush flocculent material, and enhancing deep water habitats by stabilizing bottoms and promoting the establishment of SAV beds. We dismissed that approach, because we consider marsh restoration crucial in meeting the mandates of the Refuge System.

Stevenson, et al. (2000) suggest the use of Phragmites to control erosion and entrap sediment. However, until there is convincing evidence that Phragmites is native, Executive Order No. 13112 (February 1999) mandates that Blackwater NWR prevent or control introductions of invasive species in a cost-effective and environmentally sound manner.

Management Strategies

The purpose of the proposed Habitat Management Plan is to develop a comprehensive and cohesive approach to managing the tidal marsh system. Restoration strategies will include restoring the historic marsh plug between the Blackwater River and Stewart's Canal to reduce saltwater intrusion, modifying Shorter's Wharf Road to allow tidal input (sheet flow), riprapping the pine islands, reducing sediment load run-off into the upper watersheds, and thin-layer deposition of dredged material.

Strategies for maintaining and improving floral composition will include prescribed burning to promote regrowth vigor and maintain Olney's three-square bulrush (see approved Fire Management Plan), implementing recommendations from the Nutria Damage Management Program Pilot Study to reduce nutria herbivory, implementing the approved Integrated Wildlife Damage Management Plan for resident Canada geese, maintaining the muskrat trapping and nutria rebate program, applying pesticides and prescribed burning to control invasive flora (in particular, purple loosestrife and Phragmites), and replanting in conjunction with techniques such as thin-layer deposition of dredged material. Continuing our strategic protection of additional marsh is a component of the Habitat Management Plan, which will also include a significant monitoring component, due to the dynamic history of the marsh and the planned restoration strategies.

C. Forest Management

Background

Since the development of the Forest Management Plan (1984), which was highly species-specific and focused on improving habitats for Delmarva fox squirrels and bald eagles, the refuge land base has expanded by more than 10,000 acres, much of it forested. The complexity of management programs has increased, the need for forested habitat management has increased, and public scrutiny of management programs has increased. The old plan no longer accurately represents our current situation, does not provide sufficient information for accomplishing refuge objectives, and does not conform to new Departmental or Service policies and directives.

Blackwater NWR is now more than 36 percent forest, home to several Federal-listed endangered plant and animal species, such as the Delmarva fox squirrel *(Sciurus niger cinereus*), southeastern bald eagle (*Haliaeetus leucocephalus*), swamp pink *(Helonias bullata*), sensitive joint-vetch (*Aeschynomene virginica*) and many other Service trust species. Other equally ranked species groups of concern are Neotropical migratory songbirds: specifically, forest interior dwelling species (FIDs). FIDs generally require large expanses of interior forest for breeding. The refuge encompasses some of the last contiguous, large tracts of forest in Dorchester County. The upland and wetland forested areas that surround the refuge are being cleared and converted to residential areas, agriculture, or pine monocultures, and must be protected, maintained, and actively managed to promote healthy populations of wildlife and plants. A critical need exists for forest management objectives and strategies to focus primarily on the improvement of forest health and the enhancement of forested habitats for the above-mentioned trust resources.

FIDS require large forest areas to breed successfully and maintain viable populations. This diverse group includes colorful Neotropical migrant songbirds, such as tanagers, warblers, and vireos, which breed in North America and winter in the Caribbean and Central and South America, as well as residents and short-distance migrants, such as woodpeckers, hawks, and owls. FIDS are an integral part of Maryland's landscape and natural heritage. They have depended on large forested tracts in the Chesapeake Bay watershed for thousands of years (A guide to the conservation of forest interior dwelling birds in the Chesapeake Bay Critical Area, June 2000).

FIDS also serve as "umbrella species" for a wide range of forest wildlife. They are an important component of a natural forest system. Their habitat needs overlap those of many other plant and animal species, including large mammals, many wildflowers, wood frogs, and wild turkeys. When sufficient habitat is protected to sustain a diversity of forest birds, other important forest components and micro-habitats will be protected. These may include the small, forested streams and headwaters critical for populations of fish and the vernal pools necessary for the survival of amphibians. Forest birds are also an important link in a complex food web. They spread seeds in their droppings, help control insect numbers, and are prey for species higher on the food chain. Warblers and other insectivores eat untold numbers of insects, such as spruce budworms and caterpillars, and help keep those defoliators in check (Yahner 1995).

Although most are still fairly common, populations of some forest bird species have been declining during the last 30 to 40 years. According to the Breeding Bird Survey (BBS), there was a 63-percent decline in the occurrence of individual birds of Neotropical migrant species (many of which are FIDS) in Maryland between 1980–1989. While many factors have contributed to the decline of FIDS populations, including the loss of habitat on wintering grounds and the loss of migratory stopover areas for Neotropical migrants, the loss and fragmentation of forests on the breeding grounds here in North America appear to play a critical role. FIDS are generally more successful at survival and reproduction in large older hardwood-dominated forests. However, the conversion of hardwood and mixed-hardwood forests to pine and the reduction of "old growth" forest to small isolated patches has reduced quality habitat. Prior to European settlement, old-growth forest covered an estimated 95 percent of the Chesapeake watershed (Kraft and Brush 1981). Forest coverage in Maryland today is about 44 percent (USDA Forest Service 1996). About 40 percent of the deciduous forest in the East today consists of small, isolated woodlots of relatively immature trees in agricultural and suburban landscapes. When European settlers arrived in eastern North America in the 1600s, the average height of a hardwood tree was 100 feet or more. The average height of trees in the Chesapeake Bay region today is only 60–80 feet (USDA Forest Service 1996).

The fragmented younger forest found in the Chesapeake Bay region has several negative effects on FIDS. Smaller tracts may no longer accommodate territorial requirements, provide ample food, or provide the forest structure necessary for breeding. Many tracts are too small to support species with large breeding territories, such as the red-shouldered hawk, barred owl, and pileated woodpecker. For example, a breeding pair of red-shouldered hawks require from 250 to 625 acres to sustain them. In addition to those requirements, many FIDS have additional habitat requirements. Most FIDS, even those that have small territorial requirements, will only select larger forest tracts for breeding, i.e., they are "area-sensitive" breeders. And, finally, the reduction of forest size often results in the loss of specialized habitats or micro-habitats, as mentioned above.

Forest fragmentation also increases edge habitat, which leads to indirect effects on FIDS, such as higher rates of nest predation, increased brood parasitism by brown-headed cowbirds, increased human disturbance (including noise), and increased invasion by exotic flora. Edge is most detrimental when it adjoins a lawn, agricultural field, pasture, or wide road. We define the width of forest edge at 100 m, which is consistent with the definition used by the Chesapeake Bay Critical Area Commission (A guide to the conservation of forest interior dwelling birds in the Chesapeake Bay Critical Area, June 2000), the recommended widths of riparian forests (Keller, et al. 1993), and the criteria used by Robbins, et al. (1989) to distinguish forest patches. The area inside this 100-m edge is defined as "interior" habitat, and is measured by changes in "effective area": i.e., the total forested area minus the area within the forest edge. Interior habitat functions as the highest quality breeding habitat for FIDS.

The forest within the Refuge Complex, particularly Blackwater NWR, is in dire need of active management. Throughout the history of the refuge, and more significantly in recent years, the lack of forest management coupled with other endemic processes have had significant impacts on forest health. Much of the forested land protected by Blackwater NWR was in less than desirable condition for wildlife as a result of historical poor forest management practices and the lack of planning for future habitat conditions. A large percentage of the forested land protected

earlier (1933–1969) had either been recently cleared or had been in an early stage of succession (<30 years). A harvest technique called "high-grading" has converted much of the loblolly pine–oak and loblolly pine–hardwood forests that once dominated the landscape to low quality mixed hardwood stands. Essentially, high-grading is "taking the best and leaving the rest" (Jastrzembski 1999). It removes the most commercially valuable trees from a stand and leaves the trees that are in poor condition or are undesirable species. High-grading is not considered silviculture, due to its dysgenetic effects and long-term economic and forest health implications (Helms 1998). Traditionally, the most economically important tree species was, and continues to be, loblolly pine for saw timber, pulp wood, and poles. A viable hardwood market is essentially non-existent on the Eastern Shore, thus resulting in either some degree of residual canopy or extremely heavy slash loads, which have detrimental effects on the natural regeneration of loblolly pine as well as preferred mast producing hardwoods.

At the time of their purchase, the rehabilitation of these tracts was left to natural processes. Some stands have regenerated successfully and are now immature or mature stands of both pine and pine–hardwood cover types. However, many of these regenerated and unmanaged stands are overcrowded and in dire need of silvicultural treatments to ensure optimum growth and long-term survivability. The majority of these previously harvested areas have not been as fortunate, and have been unsuccessful in their ability to regenerate the area with the same species that occupied the site prior to harvest. This in turn, has resulted in a conversion in cover type or vegetative alliance. Many of these sites are now dominated by a dense mix of woody shrubs, vines, and less desired tree species. More recently (1970–present) the Refuge Complex has been acquiring a greater percentage of lands containing mature forests. However, many of these stands also have lacked proper management, or are in the early stages of succession, and require silvicultural treatments to restore them to health.

Forest fragmentation has some of the most dramatic impacts on wildlife populations. For years, scientists have considered forest fragmentation one of the greatest threats to wildlife survival worldwide (Rochelle 1998). Many bird and other wildlife species require large blocks of forest for successful breeding, or some life stage of particular species requires a specialized type of forest habitat more likely to be found in large forested areas than in a small patch. Despite the recent use of sound forest management practices by forest landowners and the forest products industry, we are now losing forest at a rate of 100 acres per day, primarily to development. In the last 15 years alone, the Chesapeake Bay watershed's forest has declined by more than 471,000 acres, equivalent to about half of the state of Delaware (Society of American Foresters 1998). Additional estimates claim that Maryland's forest land base is decreasing by an estimated 10,000 acres per year, also primarily due to development.

The scattered pattern of modern development not only consumes an excessive amount of land, it fragments the landscape. As roads and development divide and isolate forested areas, interior habitat decreases, human disturbance increases, opportunistic edge species replace interior species, and populations of many animals become too small to persist (Weber and Wolf, 2002). Not only are wildlife habitats and migration corridors being lost, but normal ecosystem functions such as the absorption of nutrients, recharging of water supplies, and replenishment of soils are being disturbed or destroyed. Water quality has been degraded in numerous streams and rivers. Many of Maryland's wetlands have been altered by filling, drainage, impoundment, livestock grazing, logging, direct discharges of industrial waste and municipal sewage, freshwater diversion, and non-point discharge such as urban and agricultural runoff.

Increased stress and decreased vigor make our forests highly susceptible to infestations of gypsy moths and southern pine beetles, as well as many other forest insect pests and diseases. The two diseases that primarily have afflicted the forests on and around the Refuge Complex are red heart rot and oak decline. The primary cause of pine mortality in this region is red rot disease or heart decay caused by numerous species of fungi. Heart decay is the decomposition of the central stem wood of living trees, not necessarily limited to true heartwood, and is the most damaging of all types of tree diseases. It is highly common for pine in this area to develop heart rot at a relatively early age (e.g., 60 years) on lower, more flood-prone sites. Although some heart rot may be beneficial for cavity nesting birds, the resulting large-scale mortality has far more negative impacts on the ecosystem. The decomposition of their wood fiber makes infected trees unsalable and, therefore, no salvage operations can be prescribed. Through thinning and other silvicultural techniques, we aim to improve forest health, thus reducing the susceptibility to such a disease. Periodic declines and death of oaks over widespread areas have been recorded since 1900. These outbreaks, variously named oak decline, oak diebacks, or oak mortality, are caused by a complex interaction of environmental stresses and pests. The most frequent outbreaks of oak decline have been in southern New England, the Middle Atlantic States, and the Southeastern States. The disease is not limited to any one species

or species group. Outbreaks have been most frequent and severe among red oak (*Quercus rubra*), scarlet oak (*Q. coccinea*), pin oak (*Q. palustris*), and black oak (*Q. velutina*) in the red oak group, and among white oak (*Q. alba*) and chestnut oak (*Q. prinus*) in the white oak group.

Environmental stresses such as drought, water-logging, frost, or pests such as defoliating or sucking insects weaken these trees. Oaks on ridge tops and in wet areas suffer most severely from drought. Other factors, such as leaf diseases and soils that are waterlogged, compacted, or shallow, have occasionally been implicated in oak decline. Insects and diseases that cannot successfully attack healthy trees are then able to invade and kill weakened trees. The two major pests associated with oak decline are *Armillaria mellea* (Vahl:Fr.), a root disease often referred to as "Armillaria root rot," and *Agrilus bilineatus* (Weber), the two-lined chestnut borer. Dieback symptoms also can result from the effects of stress alone. Indeed, stress, if sufficiently severe or prolonged, can result in tree mortality. However, the continued decline and death of stressed oaks usually results from lethal attacks by Armillaria root rot or two-lined chestnut borers. Usually, the decline is slow, occurring over several years. Trees affected by oak decline show a general and progressive dying back from the tips of the branches. Often, tree growth is significantly reduced prior to the appearance of symptoms. The amount of food stored as starch is reduced, especially in the roots. Defoliated trees that refoliate the same season may exhibit dieback symptoms the next year. The unique relationship of cause and affect and patterns of distribution must be considered in controlling oak decline, and control efforts should focus on reducing or preventing the predisposing stress factors.

In the forest, of course, factors such as drought and frost cannot be controlled. However, management can reduce their effects. Thinning can reduce competition for moisture and nutrients and promote better physiological condition of the remaining trees. Silvicultural practices designed to encourage species best adapted to the site can help reduce the effects of drought or frost. Removal of weak and dying trees may also reduce or delay population buildup of the two-lined chestnut borer. Stress from insect defoliation can be reduced or eliminated in high-value forest stands by spraying the trees with insecticides. Oak decline is initiated by stresses, which can disappear before effects are manifested. A systematic evaluation of the problem can usually reveal the initiating factors and the agents responsible for mortality. Practices to promote good tree health can reduce the potential impacts of damage by oak decline (Wargo 2000).

Upon approval of this forest management plan and the implementation of its recommended practices, Blackwater NWR will focus primarily on improving the health and vigor of the forest while providing quality wildlife habitat for Federal trust species and other wildlife. As the forests on Blackwater NWR improve, the refuge will reduce its reliance on insecticides to control forest pests. However, the use of insecticides will never be completely eliminated, due to their lower cost and greater efficacy.

One of the most significant processes affecting the forests of Blackwater NWR and, to a lesser extent, the Nanticoke protection area, is the ongoing and dramatic rise in sea levels expected over the next 100 years. Although it is very noteworthy, it is unlikely that we will be able to effectively combat this process on a large enough scale to prevent the loss of forest habitats. Tide gauges around the Chesapeake Bay indicate that the apparent sea level in the Bay is rising at twice the global rate of 1.8 mm per year. Fragile wetland ecosystems are being lost at an alarming rate. For example, approximately 20 km^2 (5,000 acres), or one-third of the total area of Blackwater NWR, was lost between 1938 and 1988 (Leatherman 1995). Climate models indicate that the Earth's average surface temperature may increase by 1.5–4.5°C over the next 100 years.

That climatic change and several associated processes are likely to cause the sea to rise by approximately 65 cm by the year 2100 (Kearny 2000). Over time, as sea levels rise, low-lying uplands adjacent to the shore will be converted to wetlands. This conversion unfortunately is not a viable process for replacing the valuable wetlands being submerged by rising sea levels (Leatherman 1995). These accelerated rates of sea-level rise have impacted and will continue to impact the estuarine and palustrine wetlands all along the Chesapeake Bay. In addition to the dramatic loss of estuarine emergent wetlands on Blackwater NWR, sea-level rise has had significant effects on our palustrine and estuarine forested wetlands. Many acres of forest along marsh transition areas are quickly being converted to marsh type habitats. Flood-stressed trees exhibit a range of symptoms, including leaf chlorosis (yellowing), defoliation, reduced leaf size and shoot growth, sprouting, and crown dieback. Early fall discoloration and leaf drops often occur. It is also common for stressed trees to produce large seed crops in years following a stress event, such as flooding. Again, it is common for symptoms to occur over several years. The symptoms may progress and, eventually, lead to tree death, or, they may subside, indicating the tree has recovered (Bratkovich, et al. 1993).

Management Strategy

The primary emphasis of almost all forest management activities will focus on the protection and enhancement of habitat for the endangered Delmarva fox squirrel (DFS), and Neotropical migratory songbirds, most of which are FIDs. Other native wildlife will ultimately benefit indirectly from the forest management objectives carried out to improve habitat for trust species of primary concern. Where applicable specific silvicultural practices will be implemented to create or enhance habitat for other wildlife. In this plan, the forest management program will focus on the development and protection of large contiguous tracts of mature forest land to provide potential breeding habitat for FIDs of significant concern and improving the health and overall quality of forest conditions for DFS and other wildlife.

Through sound forest management and strategic land protection, Blackwater NWR will provide, at a minimum, seven contiguous mature forest patches of at least 400 acres, which reflects the minimum patch size needed to support breeding populations of 5 of 11 species of highly area-sensitive FIDs. Also under this plan, the refuge will actively manage its forested habitats to achieve the objectives of increasing the number of cores and increasing the size of existing cores to a minimum of 865 acres, which will provide habitats to support breeding populations of 9 of 11 species of the highly area-sensitive FIDs known to occur on the refuge. Through proper forest management and the other management strategies, Blackwater NWR has the potential of establishing cores that will provide breeding habitats for all 11 species.

Although the size and age structure of the cores is dictated by minimum habitat area requirements of FIDs, most forest management activities on the Refuge Complex will be performed to enhance forest conditions for the benefit of Delmarva fox squirrels and other endangered or threatened species. Second in priority will be applicable, proven forest management activities to improve the overall health of forest habitats and maintain a diversity of forest cover types, species composition, and age and size classes.

As previously stated, Blackwater NWR has the potential of providing a minimum of 5,292 acres (64 percent of the forested area) of DFS habitats through proper management. However, not all occupied or potentially occupied habitats on the refuge can be classified as optimal for DFS. Many have dense understories or midstories as a result of past timber removal operations or tree mortality due to gypsy moth. Others are nearly pure loblolly pine and contain little in the way of hard mast or cavities. Overcrowding of trees in the upper and mid-canopies is causing declines in growth rates and mast production. DFS habitats on Refuge Complex lands will be maintained or enhanced by ensuring that a minimum average stand diameter of preferred species is maintained collectively across all potentially occupied sites. A variety of TSI and regeneration harvest techniques will be employed in order to enhance growing conditions for the residual stand of trees, allowing them to attain greater diameters in a shorter period of time. Habitats for DFS will also be improved by performing timber stand improvements or selective cuttings to encourage nut-bearing trees and other food species, conducting prescribed burns to control understory and open up the forest floor, or encouraging the growth of large-crowned trees for nesting.

Blackwater NWR also contains 1,270 acres (15 percent) of recently cut-over stands ranging from 0 to 15 years in age and 227 acres (3 percent) of immature trees. With proper management, these stands have the potential of becoming quality DFS and FIDS habitat and being included into existing cores or become cores on their own. These areas will be intensely managed using the proven silvicultural techniques associated with natural and artificial regeneration, site preparation and the control of problem vegetation. Site preparation techniques will be applied in areas where natural regeneration has failed in order to enhance seed germination or prepare the area for planting. Chemical (herbicides), mechanical and prescribed burning will be used to release preferred tree species from competing vegetation.

Both even and uneven-aged systems will be employed to enhance and expand the core areas and create new cores. A wide variety of silvicultural techniques may be applied within the core to maintain forest health and desired species and age class composition. Silvicultural prescriptions known as Timber Stand Improvements (TSI) will be crucial in managing the cores, and include thinnings, release cuttings, salvage cuttings and sanitation cuttings. In most of these stands, mast production could be significantly improved through release cuttings, understory reduced through burning, and stress reduced through thinnings. Other management techniques, such as single tree and group selection, shelter-wood regeneration cuts, and pesticide and herbicide applications, will also be used to improve

forest stands within and outside core areas. Clear cutting may also occur within the core, but only if contiguous forest patches of similar size are incorporated into the core as they reach maturity or are protected.

Consequently, the core can be envisioned as dynamic, moving about in both space and time. Forest stands outside the cores will be intensively managed using both even and uneven-aged management techniques to maximize forest health and promote optimal survivability and growth for the purpose of incorporating them into existing or new cores. This may require that some of the previously mismanaged, (i.e., high-graded), neglected, or degraded stands (i.e., gypsy-moth-killed areas) be clear-cut and restored to a healthier more vigorous stands.

The greatest and, possibly, the most rewarding challenge in managing the forested habitats will be restoring and managing the more recent clear-cuts and high-graded stands. These areas are in their most manageable stage and will respond greatest to silvicultural prescriptions. One of the most effective and economic tools for ensuring survivability and optimizing growth of young trees is the use of herbicide to release desired tree species from undesirable woody tree and shrub competition.

Strategic land protection will play a significant role in establishing and enhancing the size of forest cores as well as maintaining a diversity of forest types and age classes, whereas reforestation and regeneration will be the second most effective strategy in establishing and increasing the size of the cores.

The remaining suite of forest management strategies and silvicultural prescriptions will be applied to both core and non-core forested habitats for the purpose of achieving objectives associated with maintaining and enhancing habitat for DFS, improving forest health, ensuring successful stand regeneration, maintaining a diversity of species and age classes and manipulating stand composition and structure for the benefit of FIDs where applicable and compatible with DFS management.

As cores are established and optimum or maximum potential size is achieved, we will ensure that this acreage remains constant regardless of the management activity. For example, no clear-cuts will be performed within cores unless a patch of forest of equal size and age can be incorporated to mitigate for the resultant decrease in patch area.

Timber Stand Improvements

TSI are treatments to modify or improve the growth of an existing crop of trees, but not to replace it with a new one. Specific treatments that may be used are thinnings, release cuttings, and improvement cuttings. They involve the selective removal of vegetation to allow for the expansion of the crowns and root systems of the plants that remain (Wenger 1984). When a forest is young, it always contains many more trees than it will when it is mature. One thousand or more young saplings may initially compete for a foothold on a single acre of land. Fifty years later, that same acre will only support a few hundred trees.

When forest managers thin a forest, they mimic nature by following the process of natural selection. By cutting out the weak, crooked, and over-crowded trees, the strongest trees can reach their fullest potential to provide supporting wildlife habitat. A thinned forest is typically healthier than a crowded forest. Once thinned, the remaining trees expend less energy competing with other trees and they are better able to fight off invasions of insects or disease. The trees that remain after thinning grow sturdy, thick trunks. In a thinned forest, few trees are lost to windfall, and falling branches are not a big hazard. Many species of wildlife inhabit a thinned forest. Plant diversity in the understory is especially aesthetically pleasing to hikers, hunters, and photographers.

When properly done, thinnings will benefit the forest ecosystem. They will enhance the many values we receive from our forests. Much of the existing commercial woodland in Dorchester County could be improved by thinning out mature trees and undesirable species (USDA 1998). Thinnings will allow increased sunlight to penetrate to the forest floor, which will stimulate the germination of tree seedlings as well as a wide variety of understory plants that are important wildlife foods. Cuttings to release selected trees will directly improve the diameter and crown growth, and will ultimately result in greater mast production for wildlife. Released trees will become mature sooner and attain a larger size at maturity. Authors have suggested that habitat for fox squirrels in general may be improved by leaving mature and large-crowned trees in managed forests, encouraging nut-bearing trees, and opening up the forest understory by burning or light grazing (Chapman, et al. 1982).

Whiteman and Onken (1994) suggest that the enhancement of DFS habitat on Blackwater NWR can be accomplished primarily through silviculture. They recommend that hardwood mast production be maximized and a sparse understory maintained by promoting large crown development of mast producers in the overstory. Mast production in immature stands (average dbh <12 inches) will be very limited. Although these stands can have an open understory, they typically are overcrowded and as a result have smaller crowns. A 12-inch dbh tree will generally produce 225 percent more mast than it did when it had a 10-inch dbh. Generally, mast production increases with diameter of the tree until it reaches 22–24 inches dbh, at which time mast production starts to decline as the tree becomes over-mature. The rate at which immature stands reach the desired conditions for DFS can be expedited by identifying potential hard and soft mast crop trees and performing a light thinning around these trees to encourage crown development. All TSI will result in a reduction in stand densities and tree stress, and an increase in tree growth and mast production of more desirable species.

Prescribed burning will be used throughout all forest cover types and age classes as a form of TSI. When appropriately applied, prescribed burning will benefit most wildlife species, including the endangered Delmarva fox squirrel and certain species of FIDs, by enhancing habitat and reducing hazardous fuel buildup. Prescribed burning in woodlands will aid in creating and maintaining open understory conditions favored by DFS, and promoting habitat diversity and food availability. In contrast to the gray squirrel (*Sciurus carolinensis*), the Delmarva fox squirrel often travels on the ground (Moncrief, et al. 1993) and has been shown to prefer mature forests with a "minimum of underbrush" (Moncrief, et al. 1993), closed canopies, open understories, and a high proportion of forest edge (Dueser, et al. 1988). Authors have suggested that habitat for fox squirrels in general may be improved by leaving mature and large-crowned trees in managed forests, encouraging nut-bearing trees, and opening up the forest understory by burning or light grazing (Chapman, et al. 1982). Fox squirrels have been found to prefer sites where understory closure is 30 percent or less (Allen 1982).

Fire may also reduce habitat suitability for the competing gray squirrel (Weigl, et al. 1989). Studies conducted in southeastern forests have demonstrated effects of fires on fox squirrel habitats, such as improved cone and mast production, restoration of a grassy understory, and increases in other fox squirrel foods such as fungi (Weigl, et al. 1989). Fox squirrels will probably not be able to escape fast-moving wildfires. However, they will easily escape low-intensity, prescribed, ground fires. Researchers found no evidence that prescribed burning caused significant direct mortality among fox squirrels. Wildfires will destroy leaf nests, nest trees, and fox squirrel nestlings. However, cavities used for dens and leaf nests are usually above the impact zone of prescribed burnings. Fire will also help maintain the pine–oak habitat preferred by fox squirrels, and will have a direct improvement on fox squirrel foods. Prescribed burning will also be effective for manipulating understory vegetation, reducing excessive fuel, disposing of logging slash, preparing planting sites and seedbeds, and improving wildlife habitat.

Harvesting of timber products will be viewed as a necessary evil. Some people strongly believe that the harvesting of trees will be detrimental to our environment and will be opposed to many aspects of forest management. It is true that many acres of forests are cut each year. In an average year, 186.5 million board feet of timber are harvested in Maryland for wood products. Yet much of the loss of forests in Maryland is not due to timber harvests but to land development. The Maryland Office of Planning estimates more than 10,000 acres of forests are cut each year for development! When trees are cut for development, the forest is gone forever. When trees are cut for timber, new forests usually begin to grow back immediately.

The harvesting of trees from Blackwater NWR will be performed for the primary purpose of stand replacement in order to maintain a healthy and diverse forest land base to benefit wildlife, not commercial interests. These methods are known as "regeneration harvests," and are discussed under the topic of regeneration. A certain level of older and less productive trees will be harvested to make way for new healthy and vigorous stands of trees. Stand replacement through timber harvesting and regeneration will ensure the maintenance of a diversity of forest age classes, structures and species composition. While there are many different methods of harvesting timber, there are even more habitat objectives that can be achieved through timber harvests. Clear-cutting and selective harvesting methods will be performed primarily to optimize the growth of a selected crop of trees whether it be a stand of new seedlings or residuals of a desired species. Other harvest methods will focus on ensuring and optimizing regeneration of or within a stand. The impacts of these methods are discussed under "regeneration," below.

Clear-cuts will be the primary method of harvesting trees in an even-aged system. The desired effect of a clear-cut is to start all regeneration at ground level so that the resulting timber crop is made up of desirable sun-loving species,

which are the fastest growing, straightest, healthiest, and most superior trees possible. Diverse species of food plants sprout up almost overnight after a clear-cut, and the slash provides homes for mammals and birds. A 20- to 60-year-old clear-cut is a textbook case of survival of the fittest. Because full sunlight is provided for future crop trees, rates of growth are the greatest. Clear-cut areas show 1.5 to 2.0 times the growth rates per acre than selectively cut areas. The temporary loss of forested habitat will have minimal impacts on wildlife since emphasis will be put on ensuring that adjacent habitat is provided to harbor displaced species.

Selective cuttings will be used for partial removals of trees, usually in uneven-aged stands of hardwoods to promote the growth of desired shade tolerant or intermediate tolerant species. The remaining trees will be able to better receive sufficient light, moisture, and nutrients to grow to optimal size. Part of this method will also be the manipulation of sunlight on the ground to successfully regenerate desired species. This activity will have significant beneficial impacts on the growth and productivity of desired tree species and wildlife. Selection system harvesting will allow a timber stand to retain its forested appearance in the years immediately following harvest. Disadvantages of selective cutting will be slower long-term growth, allowing undesirable species to predominate, allowing undesirable epicormic branching on future crop trees, holding back valuable sun-loving species, and being an easily and frequently abused method.

The regeneration of many species of trees will require some canopy removal to allow light to the forest floor to stimulate seed germination. Natural regeneration of desirable tree species will be the preferred method of stand replacement following prescribed management operations of any type. The advantages of relying on natural regeneration will include: lower establishment costs, less labor and heavy equipment required, the origin of the seed is usually known, reduction in chance of tip moth damage, enhanced early root development, and less soil disturbance. The methods of stimulating natural regeneration will vary widely in the amount of overstory that is removed. Therefore, the impacts on wildlife populations will also be varied. The most commonly used strategies to stimulate and enhance natural regeneration will include seed tree methods, strip or patch clear-cuts, shelterwood cuts, and single tree and group selections. A more detailed description of these and all other silvicultural techniques can be found in the “Forest Management Plan.” The overall benefits regarding regeneration and stand replacement, species composition diversity, forest health, and long-term sustainability of forest habitats will far outweigh any temporary negative impacts of executing these prescriptions.

Unfortunately, natural regeneration is not always a sure thing, and is subject to many natural and anthropogenic variables. When natural regeneration fails, or does not result in the adequate stocking of desirable species, then planting will be required. Some of the benefits of artificial regeneration will include control of initial spacing and stocking, genetically improved plant stock, less chance of seedbed loss, and less need for precommercial thinnings. The initial expense of planting, however, will be far greater than natural regeneration due to the cost of seedlings and potentially a greater amount of site preparation (Wenger 1984). The regeneration of hardwood species differs significantly from pines and is achieved through several means. For most hardwood species the planting of seedlings for regeneration will neither be necessary nor warranted. Unless control measures are taken, the planting of more shade tolerant species such as oaks in clear-cuts or large openings will not be practical since the seedlings will soon be out competed by fast growing sun-loving species such as red maple, sweet gum, and pines, as well as woody shrubs. More times than not, hardwood seedlings will require tree tubes in order to protect them from browsing herbivores and to maintain good form, which, in turn, will substantially increase planting costs.

In areas such as prior converted wetlands (agricultural fields) that will be reforested to create travel corridors or minimize fragmentation, a mix of desirable species suitable for those sites will be planted. A mix of hard and soft mast producers will be planted and maintained to ensure a successful conversion back to a diverse forested habitat. Tree shelters will likely be required on all seedlings regardless of species depending on the anticipated level of herbivore damage. Drought is a major cause of mortality for planted seedlings, especially in areas with low rainfall during the growing season. The rate of seedling mortality will be reduced by planting seedlings in early spring so that the seedlings can obtain sufficient moisture from spring rains. Proper care, handling, and planting of nursery stock and adequate site preparation for control of competing vegetation will be used to ensure proper survival by indirectly increasing moisture stress.

Sunken soils, typical of this area, are slowly being inundated by brackish waters (becoming submerged uplands), and the future use of these soils for producing quality timber is severely limited. Planting salt-tolerant species of grass,

shrubs, or trees in harvested areas helps to stabilize the soil, provide wildlife habitats, and reduce the potential for salt crusting on the soil surface (USDA 1998).

Site preparation or site disturbance will be used to promote natural regeneration of most pine species and the germination of some hardwood species. Most site preparation methods will be aimed at the preparing the seed bed through scarification. Some of the more common methods will include logging, chopping, discing, dozing, herbicide application, and prescribed burning (Wenger 1984). Scarifying the seedbed will expose mineral soil and increase contact of the seeds with moist soil surfaces. Failure of the root radicle to penetrate compacted or puddled soil surface will reduce seedling establishment, especially on major skid trails and log decks. Soil compaction and puddling also reduce root growth, seedling survival, and shoot growth. Seedbed preparation by scarification or burning will greatly increase seed germination and seedling survival, which will reduce the number of seeds required to produce one seedling.

For example, undisturbed seedbeds with a litter depth of 8 to 10 cm. (3 to 4 in) require five to six times more seeds to produce the number of seedlings produced in disturbed seed beds. Seed germination decreases with age of seed bed and increases with clay content of the soil. Two-year-old seed beds require three to four times more seed for successful establishment than do 1-year-old seed beds, and 3-year-old seed beds require 9 to 14 times more seed than is needed in the first year. Thus, favorable seedbeds usually exist for only 1 year after disturbance, after which they rapidly deteriorate (Baker and Langdon 1990). Site preparation methods like prescribed burning and herbicides will offer little to no soil scarification, but will provide more than adequate relief from competing undesirable woody sprouts (see below).

Management of problem or undesirable vegetation will be essential for ensuring optimum growth and survival of desired regeneration, whether natural or planted. By definition, when vegetation conflicts with the land management goals it becomes a weed problem. Forest weeds may be grasses, herbs, shrubs, vines, and trees of any species that interfere with the objectives whether they are timber, wildlife habitat, recreation or other uses. Weed control will increase the survivability, growth, and production of desired species, and therefore increase their wildlife benefits. Many of the more successful weed species are of exotic origin and native species are not adapted to compete. Significant occurrences of weed problems often lead to a weed or weed-dominated community replacing the trees removed. The results are brush fields or stands of undesirable species and substantially decreased value.

More specifically, competition affects the growth of loblolly pine in varying degrees depending on the site, the amount and size of competing vegetation, and age of the loblolly pine stand. Growth and survival of loblolly pine seedlings during the first 7 years after a stand is regenerated may be reduced by 80 percent because of the faster growth of competing hardwood sprouts and shrubs. Pine seedlings not overtopped by hardwoods at age 3 or older have an excellent chance to outgrow the hardwood competition (Baker and Langdon 1990). Woody species that grow rapidly from seed or sprouts are likely to be primarily a shading problem, causing mortality and loss of growth for many years after establishment. Hardy plants, especially grasses and low shrubs, are serious competitors for moisture for 1 to 3 years in areas of deficient summer moisture. Grasses that deplete moisture early in summer are among the most important causes of mortality in new regeneration (Wenger 1990).

Across the southern region, the average loss of volume production resulting from hardwood competition has been estimated at 25 percent in natural stands and 14 percent in plantations. Residual canopy, following high-grading operations, also has a detrimental effect on regeneration and stand replacement. Weeds also cause physical injury to forest regeneration. Vines, such as grape, Japanese honeysuckle, poison ivy, and Virginia creeper; aerial portions of tall herbs such as fronds; and leaves, branches and stems from woody vegetation compact and sometimes deform or break small seedlings. The systematic removal of weeds will favor the development of the desirable species. Forest weed control is simply a group of silvicultural practices for controlling certain species to benefit others.

Chemical control of woody weeds will be the least accepted method by the public. Chemical control will be used primarily in areas that are dominated by loblolly pine, where pine is the desired cover type during the early stages of seedling and sapling development, when other methods such as prescribed burning and mechanical control will cause substantial harm to regeneration. The primary benefits of chemical control are that it is generally the least expensive, causes the least amount of soil disturbance, and provides control for the longest period of time. Only approved chemicals that are labeled for these specific uses will be considered. Although many chemicals are registered and labeled site preparation and release, the most effective and widely used chemical to control woody

weeds is the isopropyl amine salt of imazypar, known by the trade name "ARSENAL." Another commonly used chemical, especially in and around areas of open or standing water, is glyphosate. An entirely different suite of chemicals may be applied systemically to individual trees in order to kill selected trees and reduce competition, while at the same time leaving the tree standing to provide additional years of shelter and foraging habitat.

Those substances, when used in accordance with their labeling, have been proven to have little to no impact on non-target fauna and flora. Extreme care will be taken to prevent drift to non-target areas as well as non-Federal lands. The Refuge Complex will continue to implement IPM strategies to reduce the use of chemicals. We will continue to explore new products as they become available in an effort to find equally effective, biologically safe, and less expensive materials to help enhance regeneration and forest conditions. All applications will be performed in accordance with current labeling and Federal, state, and local regulations. See Forest Management Plan for a list of chemicals approved for application in Region 5 and the labels from selected chemicals.

Manual methods of controlling weed species are generally limited to work with hand tools and are very labor intensive. For site preparation, hand cutting is generally followed by fire to remove the slash. Without burning, the cost of planting is very high and sprout growth is rapid. Best results are attained when the vegetation is sprayed before cutting to reduce sprouting. Nearly all common forest brush species are able to sprout vigorously after tops have been cut. Virtually no plants are killed by cutting alone. The effects on the competing brush community are limited to the temporary reduction in height and an increase in the number of stems. The regrowth of some species is so rapid that repeated treatments may be needed to accomplish release.

However, each successive treatment is more costly than the first, due to the accumulation of debris and the proliferation of sprouting stems. Treating the stumps immediately after cutting with herbicide can also be instrumental in reducing sprouting. However, a delay of more than 20 minutes between cutting and herbicide treatment will reduce the effectiveness on some species. Manual release is also a very effective method of timber stand improvement. Some additional advantages to this method are that it is highly specific and selective, and creates a source of employment that will contribute to the local economy or provide for volunteer opportunities. Some other disadvantages include high cost per treatment, difficulty in finding a willing labor force and high personal injury rate.

Mechanical control methods include grubbing, discing, bedding, chopping, and crushing. Heavy equipment may be used to grub out brush. The traditional method is to use a large bulldozer equipped with brush rakes that can uproot brush with minimal soil movement and allow soil to shake out of the roots en route to the brush piles. Traditional blades tend to shear off stems so they sprout, and also move considerable amounts of soil to the piles. Heavy equipment has a greater impact on the site than any other method, and has resulted in reductions in productivity in some southern and western operations. Roller-choppers are also very effective in crushing and breaking up undesirable woody vegetation. This method is best suited for flat terrain and small stems. If soil is dry, site disturbance is minimal. Because roots are often left intact, release may be required after several years to control new sprouts. Discing may be used to uproot weed species in previously unforested areas such as abandoned fields. The use of discing equipment is severely limited in cut over areas due to stumps and slash material. Bedding is a technique generally used in wet areas to create raised micro-environments where seedlings are planted. However, by creating micro-topography, the beds may also deter the growth of some woody species. The plowing of the beds may also result in damage to the roots of potential weeds, thus providing some level of control.

The advantages of mechanical methods are that the probability of attaining prescribed objectives is high. The operations can also provide residual browse, and can double as preparation for prescribed burning. Disadvantages include comparatively higher cost, high energy consumption, possible soil degradation, and the resulting debris may affect access and plant response.

Prescribed burning is equally effective as a tool for weed control or for TSI. Prescribed burning will be used extensively for seedbed preparation, site preparation for planting, and the control of undesirable vegetation. In the Atlantic Coastal Plain, a series of prescribed burns, such as a winter burn followed by three annual summer bums before a harvest cut, has been more effective than discing for control of competing hardwood vegetation and improvement of pine seedling growth after establishment of natural regeneration (Baker and Langdon 1990). Fire can reduce litter depth so that oak seedlings can become established. Fire can also reduce stocking rates of other

species, allowing oak species to increase in basal area. Fire can induce vigorous sprouting from older root stocks, which may be a preferred reproductive technique (Snyder 1992).

Van Lear (1992) lists several ways in which fire benefits oak regeneration. Fire removes excessive litter buildup from the forest floor, thereby preparing a favorable seedbed. Seedlings from freshly germinated acorns are unable to emerge through a heavy litter cover. Squirrels and blue jays prefer thin litter for burying acorns. Jays collect and disperse only sound acorns, which implies that any acorns not consumed have a good chance of developing into well-established first-year seedlings. Fire helps control insect predators of acorns and new seedlings. Many of these insects spend all or part of their lives on the forest floor. Infestations, which can vary from year to year and even from tree to tree in some areas, are major contributors to the oak regeneration problem. Burning also may damage rodent habitats; in turn, that will reduce the threat of these formidable acorn consumers.

A regime of frequent burning over long periods of time creates an open stand. In hardwoods, long-term burning tends to eliminate small understory stems outright and gradually reduces the midstory and overstory canopy through mortality resulting from fire wounds. Increasing the light reaching the forest floor in these open stands will maintain the vigor of oak regeneration. Severe or frequent fires xerify the surface of forest sites by consuming much of the forest floor and exposing the site to greater solar radiation through canopy reduction.

Adequate advanced oak regeneration in the East is generally found more often on xeric sites than on mesic ones. Conversion of mesic sites to more xeric conditions by intense fires or by long regimes of low intensity fires could explain in large part the ability of oaks to dominate sites where more mesic species normally occur. The absence of fire since the turn of the century has allowed species that are intolerant to fire to become established and grow to a size where they, because of thicker bark associated with age, can now resist fire (Carter 2000). Prescribed burning is comparatively cheap, causes little soil disturbance, and may enhance the availability of nutrients. However, the chance of fire escape is always a factor; smoke may degrade air quality; if fire is too hot, it may damage soils; and there is often a narrow window when treatments can be applied.

Integrated pest management is an integral part of forest management and protection. The primary strategy under our IPM program will be to improve the overall health of the forested habitats in an effort to reduce their susceptibility to forest insect pests and diseases. Until this objective is achieved, we will continue to rely on the latest and most effective control measures developed by the USDA Forest Service. Currently, the most effective and widely used control tactics is the use of biological insecticides such as *Bacillus thuringiensis* and Gypchek. Integrated Pest Management and the monitoring and treatment for disease outbreaks will be performed throughout all applicable forested habitats and therefore will not be illustrated in the Prescription Matrix, below (table 4.2). The consequences of these IPM strategies are covered under the section on exotic species control.

Table 4.2. Silvicultural prescriptions for seven years

Dimensions	***Core Areas***							***All Other Forests (current boundary)***
	1	2	3	4	5	6	7	
Current Acres	427	617	864	722	348	283	0	5,447
Effective Area	209	294	445	355	132	10	0	N.A.
Perimeter-to-Area Ratio	86	25	68	92	32	58	N.A.	N.A.
Prescriptions	*Proposed Acres If Available*							
**Crop Tree Release	100	120	250	100	100	N.A.	N.A.	1,030
**Thinning	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	630
**Improvement Cutting	N.A.	120	N.A.	N.A.	100	N.A.	N.A.	478
Regeneration and Selection Harvest	250	375	300	100	200	58	N.A.	750

Prescriptions	*Proposed Acres If Available*							
Prescribed burning (TSI)	225	280	500	250	N.A.	100	N.A.	700
**Reforestation and Planting	9	95	78	50	N.A.	7	N.A.	500
**Control Problem Vegetation	9	95	72	292	N.A.	150	N.A.	2,000
***Land Protection	507+	552	1,006	1,112	552	204	634+	N.A.
****No Management	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	2,750
Desired Acres	1,043	{1517}	1,869	2,153	{1517}	1,158	634	N.A.
Desired Effective Area	779	{959}	1,498	1,733	{959}	843	366	N.A.
Desired Perimeter-to-Area Ratio	36	{17}	29	31	{17}	12	69	N.A.

* Prescriptions have not been predetermined for those lands that have not yet been protected. As those lands are protected, they would promptly be assessed for management needs. The forest management activities would then be appended to the forest management plan and would be subject to Informal Consultation (section 7) by our Ecological Services Office.

**These activities will be performed on currently owned forest lands that are not yet incorporated into cores, but the management of these lands is crucial to enhancing the respective core. These acreages, some of which are specific to certain cores, will be reflected in the totals for this activity under the "All Other Forest" column, but will be added to the core area once they meet the minimum requirements. The reforestation of prior converted wetland is not illustrated in this table. The "Control Problem Vegetation" column also includes acres duplicated in the "Reforestation and Planting" column.

***The acreage figures for land protection represent the area of one or several priority parcels to be protected to meet the minimum optimum requirements of establishing or enhancing a core.

****The lands included under the "No Management" column are a combination of both low-lying, stunted stands that are too far gone to be managed effectively and stands that are in a condition that does not warrant silvicultural treatment within the next 15 years.

{..} The "Desired Acres", "Desired Effective Area" and "Desired Perimeter-to-Area Ratio" figures inclosed in braces are the same for both Cores 2 and 5, due to the conjoining of the two cores that will result from strategic land protection in that area.

Please note: These area values represent an estimate of management needs based on current landownership and the current condition of the forest resources on Blackwater NWR. These values and the location of management activities will change significantly as the Refuge Complex continues to expand. Also note that this is a 15-year plan, and all activities are of the highest ranking priority. The need for additional management activities may exist; however, it is unlikely that we will pursue them during the term of this plan.

Managing Forest Cores

The following cores were delineated based on the criteria relating to minimum breeding area requirement for FIDs as described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan and the Forest Management Plan for Blackwater NWR of which this document is an attachment. The criteria describes cores of having to be a minimum of 400 - contiguous acres of forests which are greater than 40 years old (ie. mature). The current refuge land base has been delineated to create four cores of 400-acres or greater and two cores less than 400-acres which exhibit the greatest potential for becoming cores. A seventh core will be established in the near future through land acquisition. Figure 4.4 below demonstrates the size and location of the four current cores. Figure 4.5 displays all seven cores in their 'unmanaged' condition as well as the projected or desired future condition of all seven cores. Although all cores are representative patches of contiguous mature forest of a minimum size and developmental stage, each core is dynamic in the fact that they are essentially revolving in both space and time. Although the general location and minimum size of a core will not change, the actual boundaries of, and forest conditions within a core, may shift as management activities are carried out or new lands are acquired. A core may not always consist of the same physical forested acres. For example: As stands within a core reach the point of over-maturity and declining health, these stands may be harvested (removed from the core), but only when adjacent parcels of forested land of equal or greater value can be incorporated into the

core to offset the decrease in patch size and effective area. Once four of the seven cores reach the optimum size of 865-acres, that acreage will then be maintained as the core's minimum size. The proposed management for each of the seven current and potential cores as well as other stands within core compartments will be prioritized based on what types of management are most likely to be accomplished with the least amount of conflicts. In most cases, the ranking for proposed forest management aimed at improving the integrity of the core will be timber stand improvement, reforestation/restoration, regeneration cutting, and controlling problem vegetation to release regeneration. A series of priority management strategies will be described both narratively and most importantly, geographically. Geographically displaying these management strategies within and around the designated core areas will provide a better understanding of the ecological significance of the management prescriptions proposed.

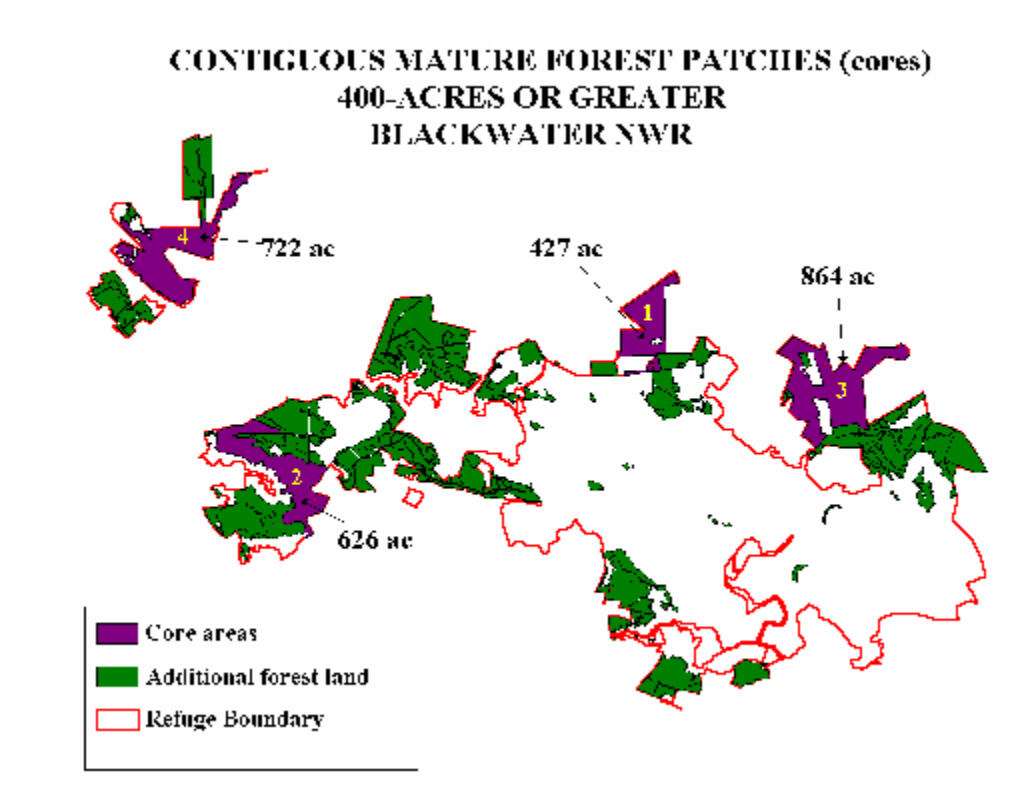


Figure 4.4.Map of four currently established forest cores.

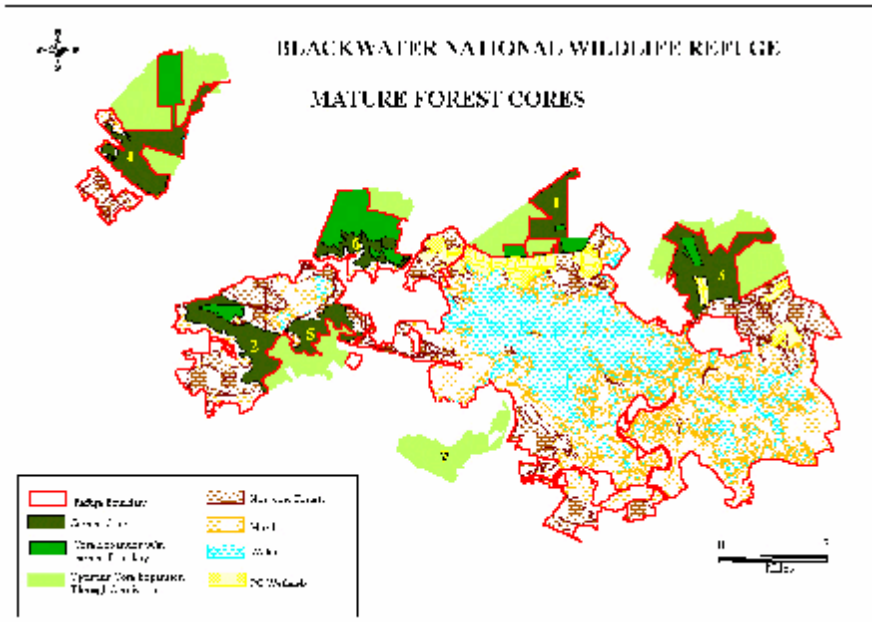


Figure 4.5. Map of all seven cores displaying current or unmanaged conditions as well as desired future conditions.

Core 1

Core 1 is a subset of forested habitats within compartment D. Core 1 was delineated by grouping all contiguous mature and over-mature stands within the compartment. The current core is comprised of 427 contiguous acres of mature and over-mature loblolly pine/hardwood forest. A more detailed description of the forests in this compartment can be found in the Affected Environment Section of this plan and the Forest Management Plan. A closed canopy road extends South to North bisecting the entire core and a secondary closed canopy road also exists in the western part of the core. The fact that these roads are narrow and are closed canopy makes them an insignificant detriment to the integrity of the core. The core is however, negatively impacted by a 9-acre abandoned field which serves in part as the refuge's bone yard. The current effective area of Core 1 within the 100-meter buffer is 209-acres and the perimeter to area ratio is 86 (table 4.3, figure 4.6). The following forest management prescriptions have been determined to be the highest priority for improving the quality of this core. The proposed actions and consequences will be described and geographically displayed.

Table 4.3. Change in core area and effective area by prescription

Prescription	*Core Area*	*Cum. Change Core Area*	*Effective Area*	*Cum. Change Effective Area*	*Perimeter-to-Area Ratio*
Current Status	427 ac.	N.A.	209 ac.	N.A.	86
Timber Stand Improvement	498 ac.	17%	243 ac.	17%	80
Reforestation	507 ac.	19%	272 ac.	31%	74
Land Protection I	637 ac.	48%	357 ac.	71%	62
Land Protection II (Optimum)	1,043 ac.	145%	779 ac.	275%	36

1.) Timber Stand Improvement.

The highest ranking management recommendation consists of performing TSI in the 71-acre stand of immature loblolly pine and hardwoods directly adjacent to the core. The stand is dominated by very dense 30-year-old pines and hardwoods with a remnant canopy of over-mature pines. In addition to an overstocking of pine, the stand also contains a high percentage of sapling and pole size oaks of various

species. The future of this oak component is severely limited by the high degree of competition from pines and less-desirable, more vigorous hardwoods. The effects of competition on oak ability to become established in the canopy are already evident. Due to their slower rates of growth and density of the stand, the oaks quickly being suppressed. In order to promote and ensure the establishment of both pines and oaks in the upper canopy of this stand prior to becoming incorporated into the existing core, it is recommended that a 'Crop tree release' be performed in this stand to reduce competition and improve growth and vigor of preferred mast producing species hardwoods and pine.

By significantly decreasing the competition for resources throughout the stand and targeting a specific number of preferred tree species for release will improve tree growth and mast production and ensure that this stand will be a healthy and beneficial addition to the core. The increase in tree growth and mast product will provide tremendous benefits for DFS as well. By adding this particular stand, the overall size of the core is increased by 16.71 percent, and the effective area is increased by 16.67 percent (34.76-acres). The perimeter to area ratio is also decreased from 86.08 to 80.47 (6.5 % decrease). By adding such a significant parcel to the core, it will allow for the regeneration or restoration of some of the older, less vigorous and unhealthy portions of the core without significantly impacting the effective area of the core. This management prescription will not result in any changes to species competition, but will directly affect stem density and stand structure for the benefit of DFS, FIDs and all wildlife. Figure 4.7 below demonstrates the consequences of implementing prescription A and how the core would be improved by the addition of this 71-acre stand. Since the age of this stand is slightly over 30-years and our definition of mature forests states an age of 40-years, this 71-acres stand will be incorporated into the core in less than 10-years. This map also provides excellent visual explanation of the consequences of each prescription.

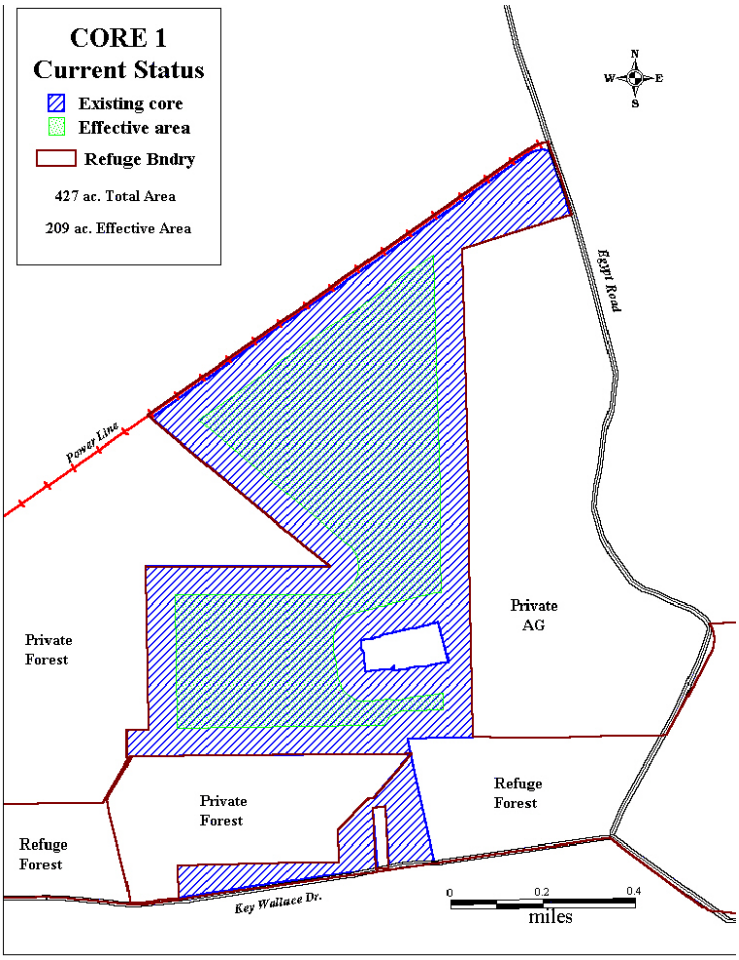


Figure 4.6. Core 1

2.) Regeneration Harvests

Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 250-acres of mature and overmature forested habitat within this core over the next 15-years. The proposed acreage is based on current conditions and current land base. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

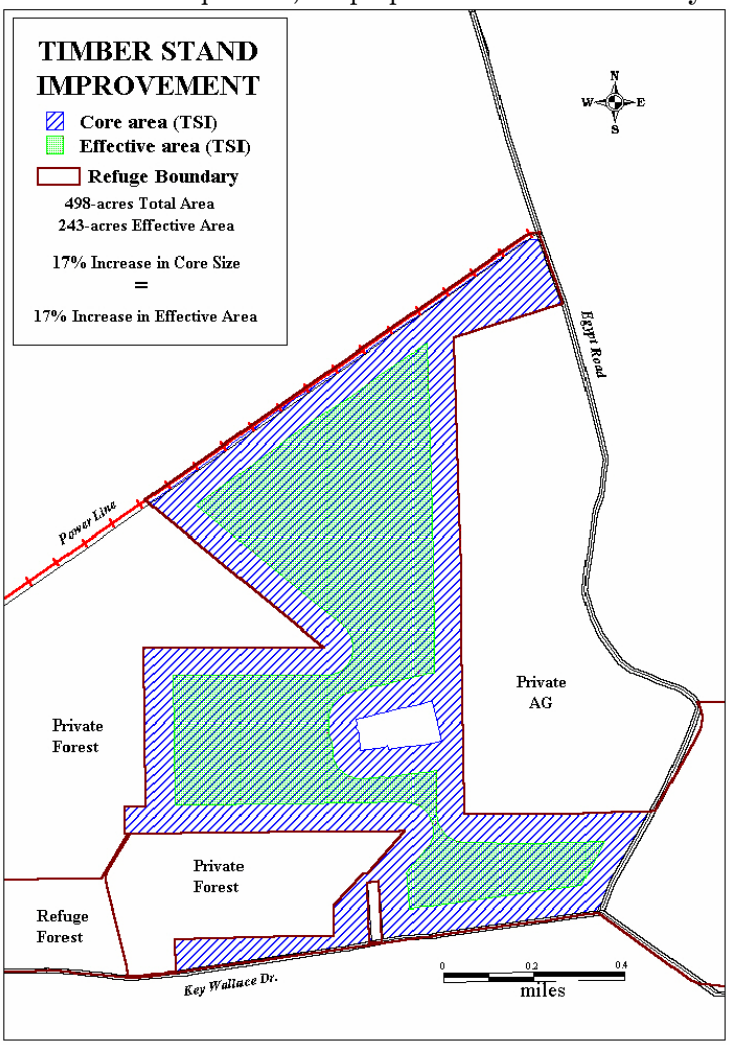


Figure 4.7. Core 1 and the consequences of performing TSI and enhancing 71-acres of immature

Core 2

Core 2 comprises 617 contiguous acres of mature forest within compartment M. This assemblage of connected pine, pine/hardwood, and mixed hardwood stands comprises possibly the most diverse assemblage of mature forested habitats on Blackwater refuge (figure 4.8). This core is highly variable with respect species composition, age class, and stand conditions. A more detailed description of these forested stands can be found in the Affected Environment Section of Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment and the Forest Management Plan. This core also exhibits some of the greatest potential for expansion through silviculture and land acquisition. However, due to its somewhat linear shape, the current 'effective area' of the core is only 294-acres. The most significant ecological factor which does, and will continue to, detract from this core is the vast areas of salt induced tree mortality. In 1987/88, more than 165 acres of large hardwoods and pines were lost due to storm tides and prolonged salt water intrusion. The following forest management prescriptions have been determined to be the highest priority for improving the quality of this core. Some of the prescriptions are to be carried out directly within the current core, while, others will be performed in forested habitats adjacent to the core which will eventually improve the integrity of the core. The proposed actions and consequences will be described and geographically displayed.

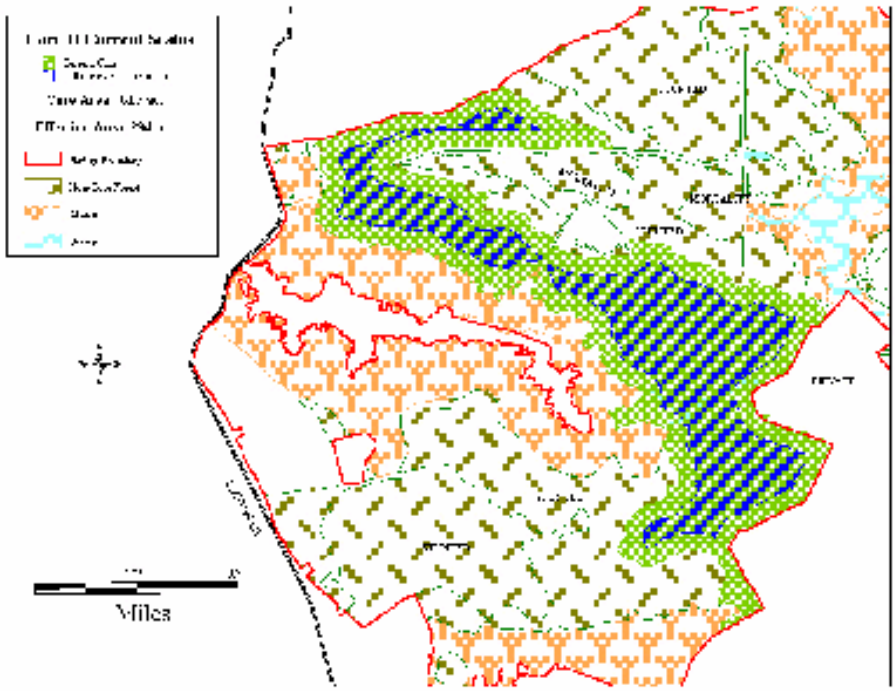


Figure 4.8. Core 2

1.) Timber Stand Improvement.
Timber stand improvement is currently proposed on only 120-acres within this core due to the fact that the majority of the stands within the current core are mature to overmature and are more in need of regeneration harvesting than thinning or crop tree release. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

2.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 375-acres of mature and overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

Core 3

Core 3 comprises 864 contiguous acres of mature hardwood dominated forest within compartment U. This expansive tract was previously harvested where the large valuable pines were extracted and the more numerous hardwoods were left. This assemblage of high-graded stands not only turns out to be the largest block of mature hardwoods on the refuge, it is also currently the largest mature forest core with the greatest amount of effective area, 445-acres (figure 4.9). In its current state, this core provides potential breeding habitat for 9 of the 11 priority FID species which we are managing for. Much of the remaining pine within the core is becoming over-mature and is of lower quality as a result of being suppressed for most of their lives. The majority of the hardwoods, particularly oaks, are also old and stressed due to the sudden changes brought on by the harvest and subsequent ingrowth of more vigorous hardwoods such as maple and gum. Past gypsy moth infestations have also taken their tole on the oaks in this area. Very little to no regeneration is occurring in many of these stands. The increased amount of sunlight reaching the forest floor following the harvest resulted in extremely dense understories which preclude natural regeneration and may have negative impacts to DFS populations. The following forest management prescriptions have been determined to be the highest priority for improving the quality of this core. Some of the prescriptions are to be carried out directly within the current core, while others will be performed in forested habitats adjacent to the core which will eventually improve the integrity of the core. The proposed actions and consequences will be described and geographically displayed.

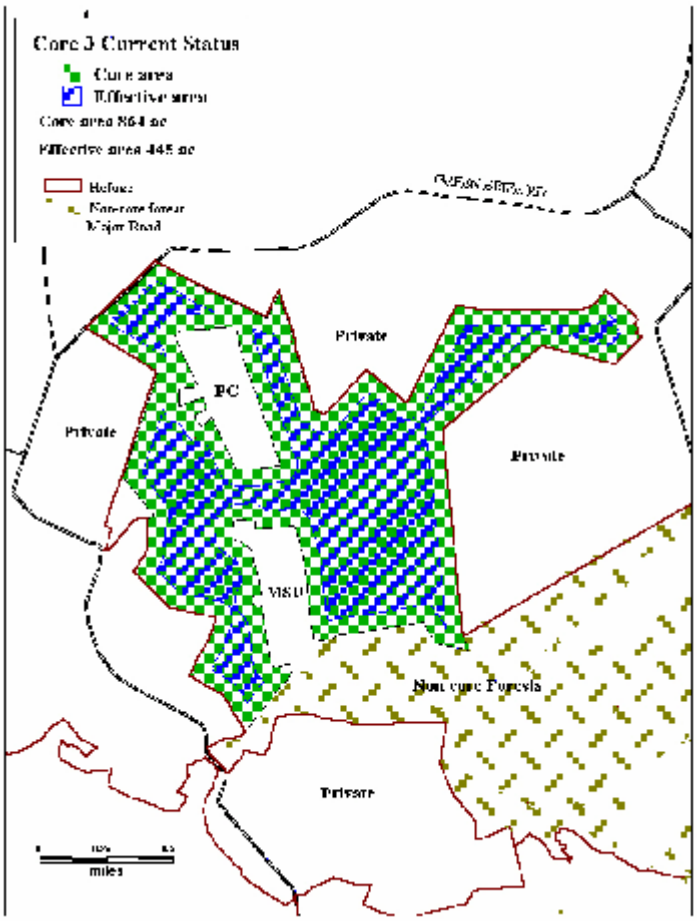


Figure 4.9. Core 3

1.) Timber Stand Improvement.
Timber stand improvement is currently proposed on approximately 250-acres within this core. The preferred method of TSI will be crop tree release or a combination of this and one other TSI method. As this core expands as a result of land acquisition, the proposed treatment acres within the core may also increase.

2.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 300-acres of mature and overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

Core 4

Core 4 comprises 722-acres of contiguous mature forests within compartment T. The effective area of core 4 is 355-acres and has a perimeter to area ratio value of 92 (figure 4.10). The current core area consists predominantly of a mixture of pine and hardwood which tapers to a pine dominated forest as it gets lower in elevation and closer to the marsh. A more detailed description of the forests in this compartment can be found in the Affected Environment Section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. The current core size of 722-acres should provide potential breeding habitat for 5 of the 11 area sensitive FIDs.

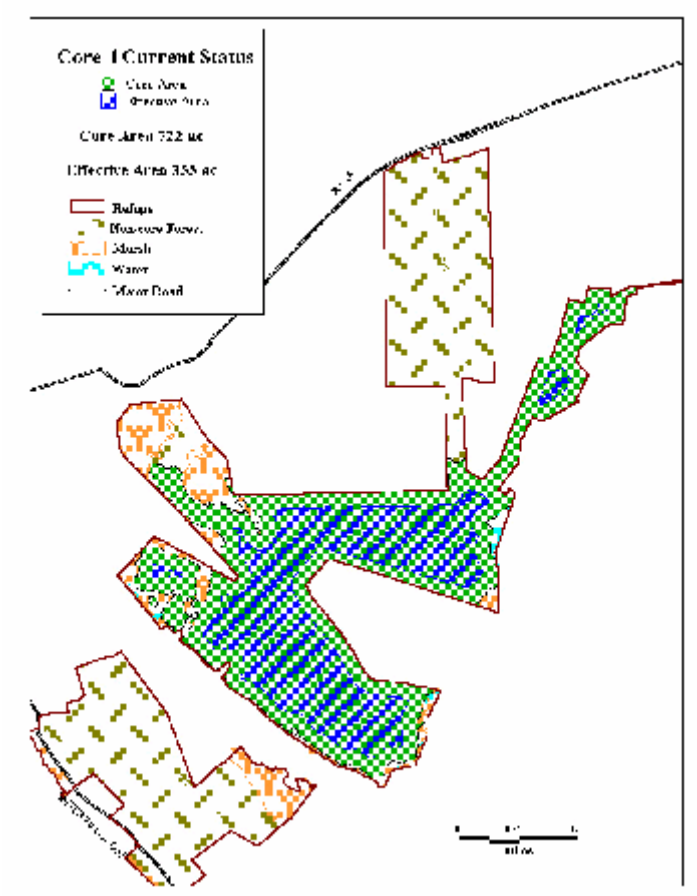


Figure 4.10. Core 4

1.) Release Cutting / TSI

Approximately 292-acres of mature loblolly pine timber had been harvested from this compartment prior to acquisition in 1994. The harvest was in the form of a clear-cut, but in areas where the hardwood was denser than pine, the pine was selectively removed and the lower-grade hardwoods were left. Many of these remnant trees were of poor health and form to begin with and continue to show signs of declining health. Although a more detailed stocking inventory needs to be performed, preliminary observations revealed that the majority of this area currently contains an adequate stocking of loblolly pine regeneration. However, the shading from the residual trees has been a significant hindrance to the growth and establishment of a new vigorous stand of trees. Oak regeneration is virtually absent from the stand, most likely due to the dense growth of more vigorous hardwood vegetation and possibly the lower prevalence of oaks in the original canopy. These factors coupled with the competition from other woody vegetation and the lack of proper management has been a significant setback in the establishment of a new stand. Other areas which served as logging decks during the operations currently contain no regeneration of any tree species. The compaction of the soil and residual debris has precluded the germination of stored or newly fallen seed. The growth and establishment of pine seedlings and saplings is currently hampered by the dense shrub competition and in some areas, shading from residual canopies. Therefore, the regeneration within these stands is in dire need of release. By ensuring the successful regeneration of these stands and their inclusion into the core we will increase the overall size of the core by 292-acres (40%) to 1015-acres. While the effective area will be increased by 173-acres (49%) to 528-acres (figure 4.11). The perimeter to area ratio value will subsequently be decreased by 12-percent from 92 to 81. Despite the significant increase in core size as a result of this activity, effective area will still be compromised due to the narrow band of forest which connects these restored lands to the original core. This wooded corridor is bordered by clear-cuts and contains no effective area for FIDs. The total effective area of the newly established core is actually not contiguous and is separated from the original core by this narrow wooded corridor. This factor will only be mitigated through the acquisition and reforestation of the adjacent lands. However, by increasing the overall size of the core to 1015-acres, the new core will potentially provide breeding habitats for all 11

species of the area sensitive FIDs listed.

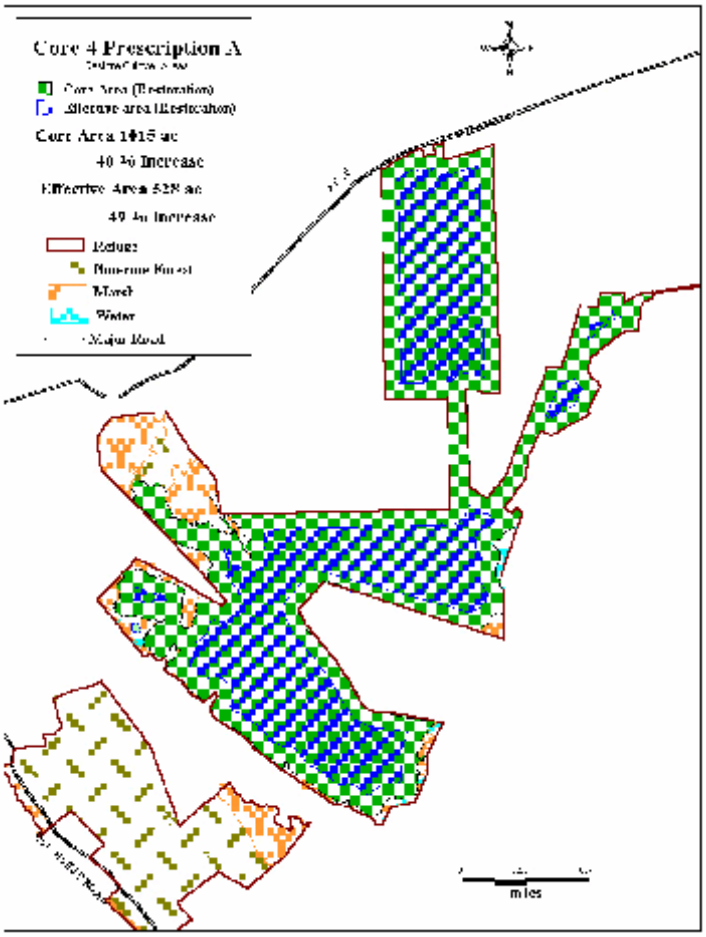


Figure 4.11. Core 4 with consequences of performing Release Cut.

2.) Timber Stand Improvement .
Timber stand improvement is currently proposed on approximately 100-acres within this core. The preferred method of TSI will be crop tree release or a combination of this and one other TSI method. As this core expands as a result of land acquisition, the proposed treatment acres within the core may also increase.

3.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 100-acres of mature and overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

Core 6

Core 6 is located within compartment R and is currently only 283-acres in size. Due to its linear shape and expansive clear-cut within its boundary, the current effective area for FIDs is only 10-acres (figure 4.12). This assemblage of mature forest stands consists primarily of pure pine forests which are located within the 'Critical Areas' and a previously high-graded overmature hardwood dominated stand. The Critical Area can be defined as a zone of protection which may extend out to 1000 feet from the mean high tide delineation along tidal wetlands and waterways. These 'Critical; Areas' are protected and governed through the Maryland Critical Area Act and regulations are enforces by the Critical Ares Commission. Therefore, no management activities will be proposed on forested areas within the designated 'Critical Area'. The only management which will be

implemented within the current core boundaries will be a very light selection harvest to promote natural regeneration within this stand. The entire future of this core hinges on the management of the surrounding immature and regenerating stands. The primary management objective will focus on enhancing these adjacent lands to someday include them into the core. The current forest conditions in this compartment are a result of timber harvesting which occurred over a 25-year period. The time factor coupled with the different harvest techniques performed under various site conditions has resulted in a highly diverse forest with respect to age class, species composition and stand conditions. A more detailed description of the forests in this compartment can be found in the Affected Environment Section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. In order to perpetuate the growth and development of stands within this compartment for the goal of establishing a core, an equally diverse combination of forest management strategies will be required. The specific commercial management practices which will be performed in the near future are discussed below.

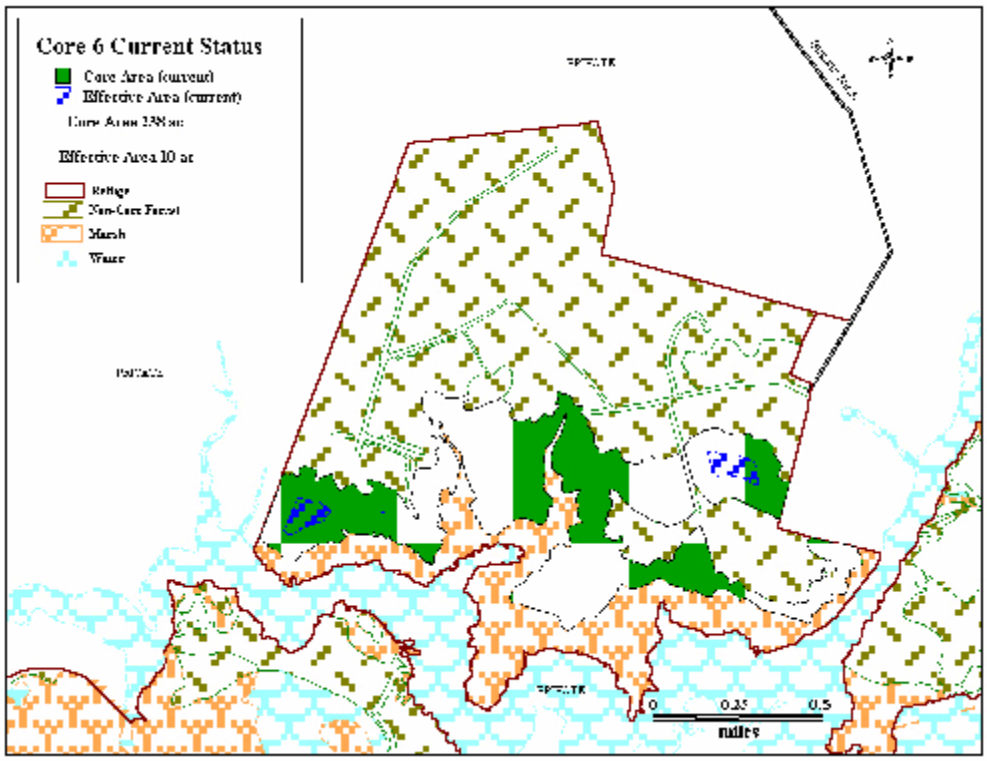


Figure 4.12. Core 6.

1.) Timber Stand Improvement

Timber stand improvement is currently proposed on approximately 87-acres within this core. It is highly likely that the preferred method of TSI will be a thinning within the 35-40-year-old pure pine stands directly North of and adjacent to the current core. The objective of this thinning will be to reduce the total basal area of the stand to between 80 and 90 square feet per acre, thus enhancing growing conditions for the remaining trees. The long term benefits to the quality of these stands will be most evident at maturity when they will be added to the core. By adding these stands to the core, the overall size of the core will be increased by 31-percent to 370-acres, while, the effective area is increased by 97-acres or 870-percent (figure 4.13). Despite the tremendous percentage increase in effective area, the size of the core remains below the minimum size requirements and will provide potential breeding habitat for only 5 out of the 11 highly area sensitive FID species.

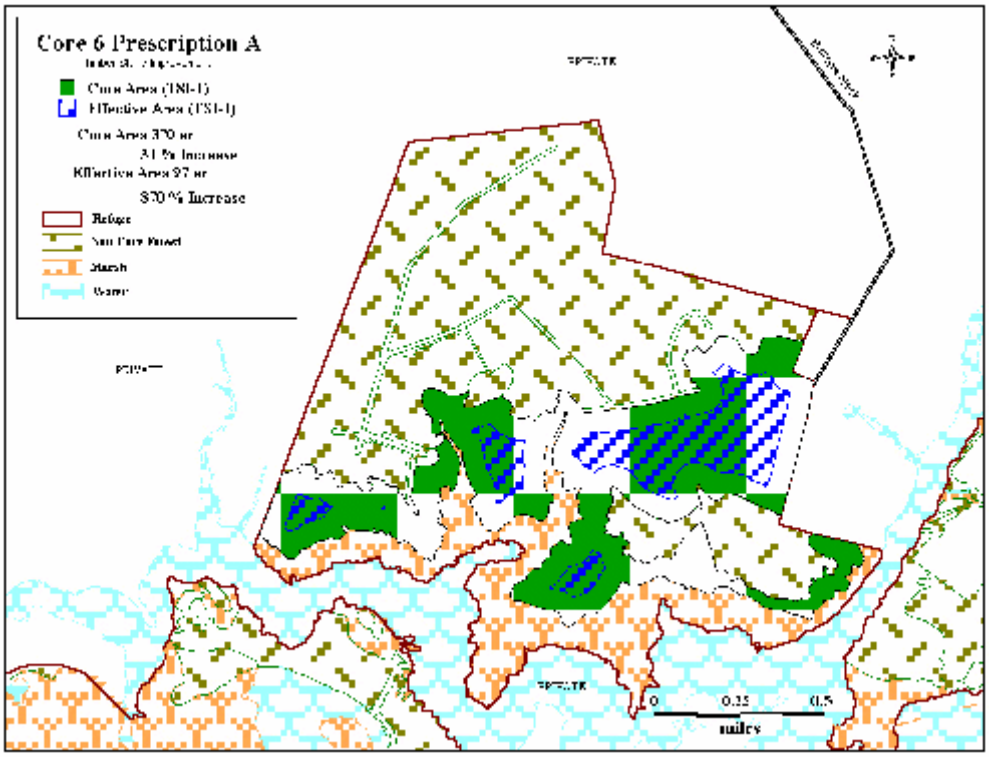


Figure 4.13. Core 6 with consequences of TSI.

2.) Release cutting

Approximately 150-acres or more of mature loblolly pine timber was harvested from this compartment prior to and post-acquisition throughout 1994 to 1999. The harvest was in the form of a clear-cut or the selective removal of residual trees left during previous harvest operations. A 66-acre clear-cut is located directly within the current core, therefore regeneration of this stand is a high priority. Although a more detailed stocking inventory needs to be performed, preliminary observations revealed that the majority of this area currently contains an adequate stocking of loblolly pine regeneration. However, dense growth of competing shrubs, vines, and *Phragmites* has significantly impacted the growth and establishment of pine regeneration. Oak regeneration is virtually absent from the stand, most likely due to the dense growth of more vigorous hardwood vegetation and possibly the lower prevalence of oaks in the original canopy. These factors coupled with the competition from other woody vegetation and the lack of proper management have been a significant setback in the establishment of a new stand. Since the original stand was a predominantly pine forest, it will be our intent to manage this area for similar future conditions. If it turns out that loblolly pine stocking levels are more than adequate throughout much of the stand, and oak regeneration is not occurring, management strategies will focus on improving the growth of the existing pine regeneration. As previously stated, the growth and establishment of pine seedlings and saplings are currently hampered by the dense shrub competition and in some areas, shading from residual canopies. Therefore, the regeneration within these stands is in dire need of release. The actual inclusion of these lands to the current core will not take place for another 35-years when the stand has reached maturity. By not managing these areas, we will increase this time frame considerably. The actual impacts of including these areas in the core have been analyzed and illustrated below in figure 4.14.

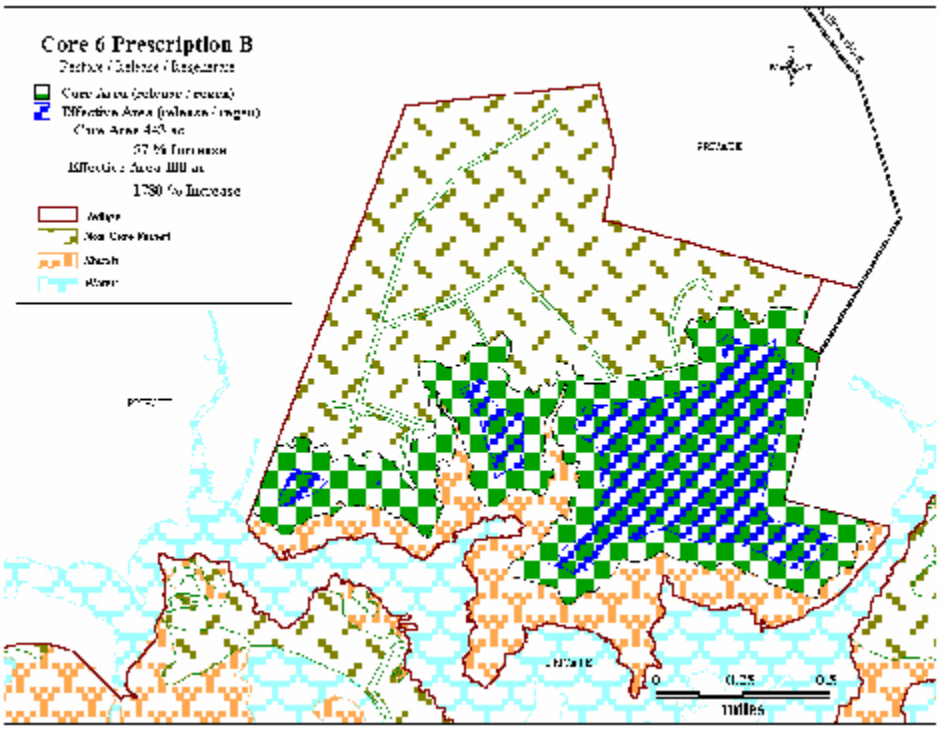


Figure 4.14. Core 6 with consequences of Release.

3.) Timber Stand Improvement 2 .

A variety of timber stand improvement techniques will be used within the next 15-years to improve growing conditions for preferred species on approximately 580-acres of previously harvested land. These areas were virtually clear-cut with the exception of some small hardwood dominated pockets which were high-graded. These previously pine dominated areas have since regenerated to a hardwood dominated forest consisting of mostly red maple and sweet gum. Due to the dense and vigorous growth of these early successional species, pine regeneration is sparse and oak regeneration is almost non-existent. The age of the newly established stand is 10 to 15 years. Due to the lack of management during the early stages of stand regeneration, management at this stage will be extremely labor intensive and very expensive. By enhancing conditions of these acres along with the cut-over areas discussed under the previous prescription and ensuring that they eventually become part of the core will significantly increase this core's ability to provide potential breeding habitat for FIDs. By including these areas (in addition to the 87-acres of immature pine stands) we will collectively increase the overall size of the core by 671-acres (237%) to 954-acres. Whereas the effective area will be increased by 642-acres, or an unbelievable 6,420-percent, to 652-acres (figure 4.15). The perimeter to area ratio value will subsequently be decreased by 76-percent from 58 to 14. The resulting 954-acre core will provide potential breeding habitats for at least 9 of the 11 area-sensitive FIDs listed.

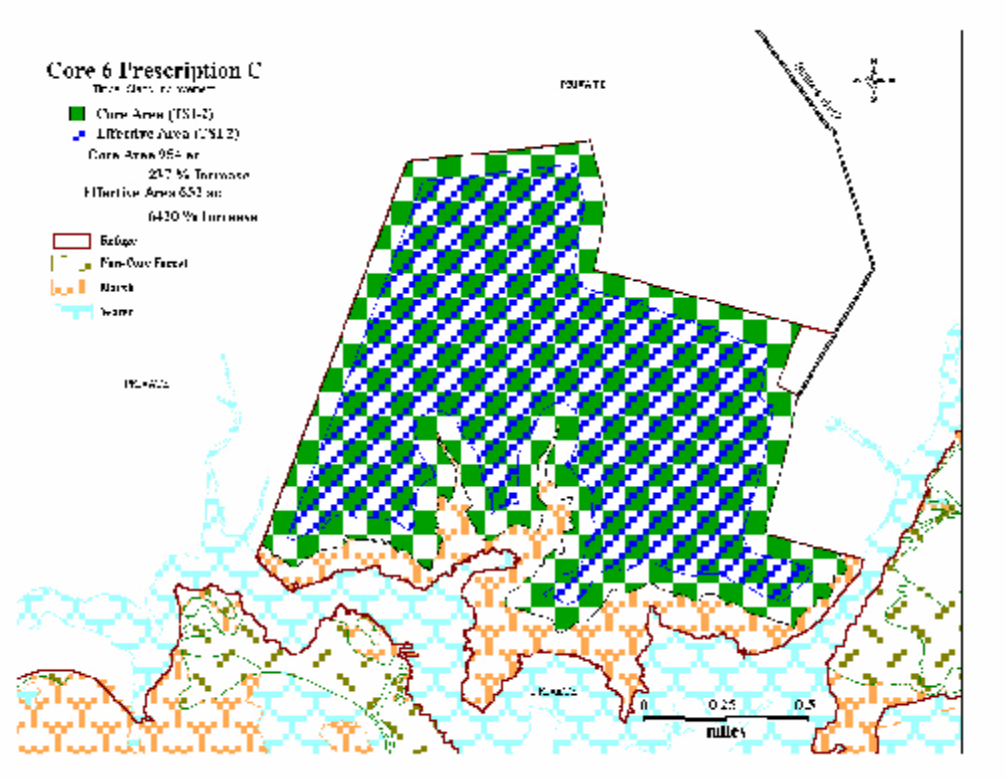


Figure 4.15. Core 6 with consequences of TSI 2.

4.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under the mature canopy of high graded stands may be performed on approximately 58-acres of overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

The management prescriptions which will be proposed on non-core forest habitats are of somewhat less significance and will not be described in as great a detail. Additional forest management will continue to be performed within the current refuge boundary as well as newly acquired lands, however many of these specific management needs cannot be projected at this time without additional inventories and data collection. Future and ongoing management of the forest habitats will be driven by the same management goals and objectives which led us to the development of the following management strategies.

Core 7

1.) Prescription A. Land protection

Core 7 will consist of a combination of several parcels of land that are currently in the approved Conservation Biology for Trust Species Diversity yet are not under Federal ownership. These parcels are located to the north and south of Blackwater Road and have the potential of creating a 634-acre core of mature mixed pine and hardwood forested habitats. The effective area and perimeter-to-area ratio value of this core will be 366 acres and 69, respectively. No silvicultural prescriptions have been proposed for this core, since it essentially does not exist yet. However, all forested habitats will be assessed as they are protected to determine management needs. Newly protected forest lands and their management prescriptions will be appended to this plan and the forest management plan at each of the 5-year updates.

Prescriptions Common to all Forested Acres (Core and Non-core)

Timber Stand Improvements

Timber Stand Improvements (TSI), which include, but are not limited to, crop tree release, thinning, and improvement cutting, may be performed on as many as 2800 acres of immature and mature stands on Blackwater NWR that are stressed due to overcrowding and competition for resources. These techniques will most likely also be employed on the Nanticoke protection area, however, an acreage estimate could not be derived at this point. These intermediate cuttings will result in improving the growth of an existing crop of trees, but will not result in stand replacement. The selective removal of less preferred, overstocked, intermediated and co-dominant vegetation will allow the expansion of the crowns and root systems of remaining trees. The vacancies created in the growing space will not be large or permanent enough to allow height growth of any new trees that become established as a result of the treatments.

When a forest is young, it always contains many more trees than it will when it is mature. One thousand or more young saplings may initially compete for a foothold on a single acre of land. Fifty years later that same 1-acre of land will only support a few hundred trees. Performing thinnings of various types in overstocked stands will free up nutrients and other resources and promote faster growth rates, greater mast production and healthier trees. Thinning overcrowded stands will significantly reduce competition and decrease stress. Competition affects the growth of loblolly pine in varying degrees depending on the site, the amount and size of competing vegetation, and age of the loblolly pine stand. Across the southern region, average loss of volume production resulting from hardwood competition has been estimated at 25 percent in natural stands and 14 percent in plantations.

In a crowded forest, trees tend to grow very tall due to competition with its neighbor for sunlight. Tall trees in a crowded forest usually have very thin trunks. All new growth goes toward obtaining height, not girth. While crowded trees are constantly competing with each other, they also depend on each other for support. Tall, thin trees cannot support the weight of their own branches by themselves. The interwoven branches of crowded trees provide support for one another. Openings that naturally occur in a forest due to one or more trees falling will result in several thin-trunked trees losing their support. In an opening, a thin-trunked tree will suddenly find itself being buffeted by the wind, causing the trunk to sway. In response to the bending, the tree will add wood to its stem to stabilize itself. Growth hormones allow the tree to direct the growth to the stem when environmental conditions require it. The fact that trees can concentrate growth in a specific region of the tree in response to external environmental conditions is valuable knowledge to a forest manager.

By thinning forests, land managers mimic nature by following the process of natural selection. By cutting out the weak, crooked, and over-crowded trees, the strongest trees can reach their fullest potential. A thinned forest is typically healthier than a crowded forest. Once thinned, the remaining trees will expend less energy competing with other trees, which will enhance their ability to fight off invasions of insects or disease. The trees that remain after a thinning will grow sturdy, thick trunks and few will be lost to windfall.

Wildlife will benefit from these thinnings due to both the increased growth and mast production as well as the abundance of new food available on the forest floor. Most of the plants used by wildlife for food grow on the forest floor and require sunlight (Jastrzembski 2000). Thinning forest stands will temporarily increase the amount of sunlight hitting the forest floor, which will allow for the germination of many new plants. The resulting plant diversity in the understory is especially aesthetically pleasing to hikers, hunters, and photographers. When properly performed, thinnings will benefit the entire forest ecosystem and enhance the many values we receive from our forests. Thinning will also help to reduce the risk of oak decline by reducing competition for moisture and nutrients and promote better physiological condition of the remaining trees. Silvicultural practices designed to encourage species best adapted to the site can help reduce the effects of drought or frost. Removal of weak and dying trees may also reduce or delay buildups of two-lined chestnut borers.

Release cuttings (crop tree release) will result directly in increased growth rates and mast production and may also be used to regulate or modify species composition in a young stand. Precommercial crop tree releases will increase tree diameters and help ensure survival. Released trees will become mature sooner and attain a larger size at maturity. Crop tree selection will always focus on healthy trees with well-formed crowns, and should include species from both the red and white oak groups along with beech and pine. The crop tree species diversity will promote a

more consistent mast crop (Whiteman and Onken 1994). Crop tree selection will also focus on mast production, providing dens and timber quality. Crop tree release will consist of cutting only trees that are directly competing with crop trees. The process will not consist of selecting crop trees and cutting all other trees in the stand. Therefore, an acceptable level of species diversity and richness will be maintained.

Mast producing hardwoods, when released, will be able to respond by increasing both height and diameter growth and most importantly crown diameter. Hardwood mast production can be maximized and a sparse understory can be maintained by promoting large crown development of mast producers in the overstory. Mast production in immature stands (average dbh < 12inches) is likely to be very limited. Although these stands can have an open understory, they typically are overcrowded and as a result have smaller crowns. A 12-inch dbh tree will generally produce 225 percent more mast than it did when it had a 10-inch dbh. Generally mast production increases with diameter of the tree until it reaches 22–24 inches dbh, at which time mast production starts to decline as the tree becomes over-mature. The rate at which immature stands reach the desired conditions for DFS can be expedited by identifying potential hard and soft mast crop trees and performing a release cutting around these trees to encourage crown development (Onken and Whiteman 1994).

Loblolly pines that have developed in a suppressed condition respond in varying degrees to release. Increases in diameter growth after release are related to live-crown ratio and crown growing space. Trees of large diameters generally respond less than trees of small diameters. Trees with well-developed crowns will usually respond best to release. Trees long suppressed may grow much faster in both height and diameter after release but may never attain the growth rate of trees that were never suppressed (Baker and Langdon 1990). The following map illustrates the approximate location of stands in which timber stand improvements are likely to be performed over the next 15 years on Blackwater NWR.

Regeneration Harvests

Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy may be employed on as much as 2,033 acres of mature and overmature forested areas on Blackwater NWR over the next 15 years. These techniques most likely will also be employed on the Nanticoke protection area; however, an acreage estimate could not be derived at this point. A variety of the previously mentioned regeneration treatment will be implemented and closely monitored to evaluate the level of success for each technique. The various methods may consist of single tree and group selection, shelterwood, seed tree or strip and patch cuts. The most frequently used methods will be single tree selection and shelterwood techniques due to the minimal impacts on the forest canopy and the lesser effects on the integrity of the cores. Performing these prescriptions will have no direct impacts on the size, effective area or perimeter-to-area ratio of the core.

Additional techniques such as group selection, strip and patch cuts and seed tree harvests will only be used when it has been determined that they are the only or best option for regenerating an over-mature or unhealthy stand. Within core areas, these methods will only be performed when lands of equal or greater quality in terms of acres, age and species composition can be added to the core to offset the temporary impacts on the size and perimeter-to-area ratio of the core.

Performing regeneration harvests in some of the mature and over-mature stands throughout the Refuge Complex will reduce the potential for forested habitats to become stagnant. As trees become over-mature and reach the end of their life, as is the case with many pines in these stands, their growth rates slow considerably and mast or seed production is severely reduced. The selective removal of dominant and co-dominant canopy trees that are nearing the end of their life will allow necessary light to reach the forest floor to facilitate seed gemination and free up additional resources to enhance the growth of new regeneration.

In most cases, the resulting natural regeneration will likely be dominated by pine, red maple, sweet gum and possibly beech. Due to the many complications related to the germination of oak seeds, such as parasitism, predation, and other various site conditions, it is likely that oak regeneration will be minimal. The planting of oak or other hard mast producing species may be required in these openings in order to ensure their replacement and continued occupancy of the stand. Additional future silvicultural treatments may be required to ensure survival and optimum growth of new trees, thus increasing their chances of achieving dominance in the stand.

Creating openings in the canopy will not only enhance natural regeneration but will also enhance growth and mast production of remaining trees, much like a crop tree release. The perpetuation of the stand through promoting regeneration and the associated improvements in mast production will have significant long-term benefits for DFS. Future implementation of TSI techniques will ensure that the species composition of these stands is not significantly altered. The following map demonstrates an approximate location of regeneration harvest to be performed over the next 15 years on Blackwater NWR.

Reforestation and Planting

Reforestation or tree planting may need to be implemented on as much as 500 acres of recently harvested forest lands pending results of regeneration survey. Harvested areas that are stocked with less than 500 trees per acre of either pure pine or a mix of pine and hard mast producing hardwoods will require supplemental planting. These measures will be implemented to ensure that these areas regenerate and replace the harvested stand with a new stand of the same cover type and species composition. Assisting the regeneration of replacement of pine and hard mast producing hardwood will reduce the chances of these areas converting to nearly pure red maple and sweet gum stands.

In areas where the stocking of preferred species is extremely low or nonexistent and undesirable vegetation has dominated the site, site preparation will be required before supplemental planting takes place. Some areas may still contain seed trees that continue to provide a fresh seed source. However, as a result of dense undesirable vegetation and less than desirable seed bed conditions, these seeds are unable to germinate. Site preparation techniques will be employed to improve the likelihood of successful seed germination. Site preparation methods may be performed in conjunction with methods to control competing vegetation (below) when necessary.

Subsequent treatments to reduce competition will also be implemented to ensure the survival and dominance of preferred species. It is highly probable that these same strategies will be implemented on similar lands within the Nanticoke protection area. Restoring these heavily cut over areas will significantly improve the fragmentation of forested habitats and in many cases directly enhance core areas. Sustaining and managing our forests to their optimum potential will provide long-term benefits to the health of the Chesapeake Bay watershed.

This acreage estimate does not include the 60+ acres of prior converted wetlands that will be restored to forested habitats, unless it is directly related to enhancing the integrity of a core. All of the prior converted wetlands that currently are slated to be reforested are illustrated in the “Prior Converted Wetlands Management Program.” The map below illustrates the approximate areas that may require.

Control of Problem Vegetation, Regeneration Release, and Site Preparation

Undesirable vegetation is widespread throughout the forest of North America. By definition, when vegetation conflicts with the land management goals it becomes a weed problem. Forest weeds may be grasses, herbs, shrubs, vines and trees of any species that interfere with the objectives whether they are timber, wildlife habitat, recreation or other uses. The control of weed species will be performed on approximately 2,000 acres of currently owned cut over areas or abandoned agricultural fields. Most weed control is performed to enhance timber production but wildlife habitat goals are also achieved through weed control. Weed control in these areas will increase the survivability, growth and production of desired species and therefore increase their wildlife benefits.

Forest weed problems are usually a result of human activities, such as logging or abandonment of agricultural fields. Many of the more successful weed species are of exotic origin, against which native species are not adapted to compete. Significant occurrences of weed problems often lead to a weed or weed-dominated community replacing the trees removed. The results are brush fields or stands of undesirable species and substantially decreased value. The systematic removal of weeds favors the development of the desirable species. Weed control will also ensure faster establishment and maturation of desired tree species. Forest weeds, if not treated may preclude the production of more desirable species for decades or centuries. We must also take into considerations that forest weed control operations are extremely visible and may result in a certain level of public scrutiny. However, through sound public education efforts, this issue should be resolved before it becomes an issue.

Nonchemical methods of forest weed control tend to disturb soils and be limited in effectiveness. They may even stimulate other weed problems. The use of chemicals for the control of woody weeds is probably the least accepted method by the public. However, it is generally the least expensive, causes the least amount of soil disturbance, and provides control for the longest period of time. All applications will be performed in accordance with current labeling and Federal, state, and local regulations. Therefore, negative biological impact will be minimal.

Manual methods of controlling weed species are generally limited to work with hand tools and are very labor intensive. The effects of manual weed control methods on the competing brush community are limited to the temporary reduction in height and an increase in the number of stems. The regrowth of some species is so rapid that repeated treatments may be needed to accomplish release; However, each successive treatment is more costly than the first due to the accumulation of debris and the proliferation of sprouting stems. Some other disadvantages include high cost per treatment, difficulty in finding a willing labor force and high personal injury rate.

Mechanical control methods include grubbing, discing, bedding, chopping, and crushing. Heavy equipment has the greatest impact on the site than any other method and has resulted in reductions in productivity in some southern and western operations. The advantages of mechanical methods are that the probability of attaining prescribed objectives is high. The operation can also provide residual browse and can double as preparation for prescribed burning. Disadvantages include comparatively higher cost, high energy consumption, possible soil degradation, and the resulting debris may affect access and plant response.

Bedding is generally used in wet areas to create raised micro environments where seedlings are planted; however, by creating microtopography, the beds may also serve as a deterrent to the growth of some woody species. The plowing of the beds may also result in damage to the roots of potential weeds thus providing some level of control.

Prescribed burning will be used extensively for seedbed preparation; site preparation for planting; and the control of undesirable vegetation. Prescribed burning benefits oak regeneration in several ways (Van Lear,1992). Fire removes excessive litter buildup from the forest floor, thereby preparing a favorable seedbed. Areas of thin litter are preferred by squirrels and blue jays for acorn burial. Jays collect and disperse only sound acorns, which implies that any acorns not consumed have a good chance of developing into well-established first-year seedlings. Seedlings from freshly germinated acorns are unable to emerge through a heavy litter cover. Fire helps control insect predators of acorns and new seedlings. Many of these insects spend all or part of their lives on the forest floor. Infestations, which can vary from year to year and even from tree to tree in some areas, are a major contributor to the oak regeneration problem. Burning may also cause damage to rodent habitats which, in turn, will reduce the rodents' consumption of acorns.

Severe or frequent fires will tend to xerify (dry) the surface of forest sites by consuming much of the forest floor and exposing the site to greater solar radiation through canopy reduction. Adequate advanced oak regeneration in the East is generally found more often on xeric sites than on mesic ones. Conversion of mesic sites to more xeric conditions by intense fires or by long regimes of low intensity fires could explain in large part the ability of oaks to dominate sites where more mesic species normally occur. The absence of fire since the turn of the century has allowed species that are intolerant to fire to become established and grow to a size where they, because of thicker bark associated with age, can now resist fire (Carter 2000).

Prescribed burning is comparatively cheap, causes little soil disturbance, and may enhance availability of nutrients. However, the chance of fire's escaping is always a factor; smoke may degrade air quality; if fire is too hot it may damage soils; and, there is often a narrow window when treatments can be applied. Fire will induce vigorous sprouting from older root stocks of oaks and other hardwoods, which also may prove to be a preferred reproductive technique (Snyder 1992).

Prescribed burning (for TSI)

Prescribed burning will be used to enhance wildlife habitat and forest condition on approximately 2055 acres of currently owned forested habitats. Conducting a single prescribed burn in areas that contain an extremely dense understory will provide temporary control woody and herbaceous vegetation in the understory. A series of two or more annual burns will provide a significantly greater period of control, thus enhancing habitat quality for DFS. The

reduction in understory density will improve the ability for DFS to forage and escape predators. Prescribed burning will also be used to reduce excess fuel loads that have built up over the years due to a lack of or poor management.

Prescribed burnings in forested habitats will benefit most wildlife species including the endangered Delmarva fox squirrel and certain species of FIDs through hazard reduction and habitat enhancement. Prescribed burning will assist in maintaining open understory conditions that are favored by DFS and promoting habitat diversity and food availability. Studies conducted in southeastern forests have demonstrated effects of fires on fox squirrel habitats, such as improved cone and mast production, restoration of a grassy understory, and increases in other fox squirrel foods such as fungi (Weigl, et al. 1989). Fire will help maintain the pine and pine–hardwood habitats preferred by fox squirrels and will directly increase the availability of fox squirrel foods. Prescribed burning at 2- to 5-year intervals can be beneficial to fox squirrels by maintaining an open understory and better foraging habitat.

Responses of the understory to prescribed burning will vary with frequency and season of burning. Periodic winter burns keep hardwood understories in check, while a series of annual summer burns usually reduces vigor and increases mortality of hardwood rootstocks (Baker and Langdon 1990). Dormant-season prescribed burning is often used in hazard fuel reduction practices, and is frequently used on the mid-Atlantic coastal plain. Studies in southeastern forests (Wade and Lunsford 1988) have shown that growing-season fire can be more effective at reducing forest understory and other woody cover. While dormant-season fires top-kill woody plants, many species resprout vigorously following such fires, using stored energy reserves. In contrast, growing-season fires are more likely to damage root collar tissues (Wade and Lunsford 1989), reducing vegetative resprouting. Growing-season fires kill aboveground woody plant organs after plants have mobilized photosynthate reserves, making such plants less competitive.

Common understory plants targeted for reduction to benefit fox squirrels include vines such as greenbrier (*Smilax* sp.), Virginia creeper (*Parthenocissus quinquefolia*), and Japanese honeysuckle (*Lonicera japonica*), and mid-story species such as sweet pepperbush (*Clethra alnifolia*), American holly (*Ilex opaca*), sweet gum *(Liquidambar styraciflua)*, black gum (*Nyssa sylvatica*) and even red maple (*Acer rubrum*). Growing-season fires may be more effective at reducing cover of these species than dormant-season fires. The open stands produced by fire will result in better pine cone and hardwood mast production. Pines and oaks growing in the open receive more light, maintain more branches at lower levels, and produce heavier crops of cones and acorns. Additionally, nutrient availability and the enhanced vigor of burned pine forest are associated with larger crops of fungi, which are also important fox squirrel foods. A lush, grassy understory maintained by fire is important as protective cover.

Fox squirrels may not be able to escape fast-moving fires; however, they could probably easily escape low-severity ground fires. Researchers found no evidence that prescribed burning caused significant direct mortality among fox squirrels. Wildfires could destroy leaf nests, nest trees, and fox squirrel nestlings. However, cavities used for dens and leaf nests are usually above the impact zone of prescribed burnings. Care will be taken to protect den and nest trees.

Fire has probably been a determining factor in the niche separation between gray and fox squirrels on the Coastal Plain. Both exist in mixed pine–oak forests and feed heavily on acorns, but the more competitive gray squirrel dominates where the overlap of oak crowns allows tree-to-tree travel throughout the canopy. Fox squirrels are more abundant where patches of oaks comprise less than 30 percent of pine–hardwood stands and do best in fire-type pine forests with scattered hardwood inclusions. Fire could be a deciding factor in determining the availability of suitable habitats and resources for one or the other species. Fire may also have a negative effect on fox squirrels by destroying acorns in the forest duff layer.

While it suggested that prescribed burnings are beneficial for Delmarva fox squirrels, the potential impacts on other species, such as breeding or wintering bird communities in coastal plain forests are unknown. Changes in the structure and function of the plant community may influence the productivity of individual bird species, and affect seasonal avian community structure and richness. Some members of the avian community in mature forests of the coastal mid-Atlantic nest or forage on the ground; e.g., Common Flicker (*Colaptes auratus*), Black and White Warbler (*Mniotilta varia*), and Louisiana Waterthrush (*Seiurus noveboracensis*). Species such as the White-eyed Vireo (*Vireo griseus*) nest and forage in the shrub canopy. Wintering species, such as the Hermit Thrush (*Catharus guttatus*), forage on the ground while other winter species, such as Yellow-rumped Warbler (*Dendroica coronata*), depend upon food and cover from mid-story plants such as poison ivy (*Toxicodendron radicans*), winterberry (*Ilex*

verticillata), American holly and greenbrier. Ground- and mid-story nesters and foragers may be affected by prescribed burning through elimination of escape or nesting cover, foraging substrate, and shrub and vine foods. Growing-season fires may directly disrupt breeding activities for ground- or mid-story nesters if carried out during peek breeding seasons (Mitchell 2000).

The acres shown under "Prescribed burning" in the "Silvicultural Prescriptions Matrix" reflect only those acres that will benefit from prescribed burning in the near future based on current conditions. As conditions change in other forested areas and new lands are protected, these figures will change significantly during the life of this plan. These acres do not reflect those lands that the Refuge Complex Fire Management Officer or Fire Control Officer declares as having excess fuel loading and as wildfire hazards. Hazardous fuel reduction burns may be performed at the discretion of the Fire Management Officers, with informal coordination with Biological and Management Staff to determine any significant negative impacts on wildlife populations or their habitats and Refuge Complex infrastructures.

Prescribed burning is not only effective for manipulating understory vegetation to enhance wildlife habitat, but also for reducing excessive fuels (hazard reduction), disposing of logging slash and preparing planting sites and seedbeds. For more details on the environmental consequences of prescribed burning please refer to the "Fire Management Program" section of this document as well as the "Fire Management Plan" and associated Environmental Assessment for Blackwater NWR.

Restoration of Atlantic white cedar on Nanticoke protection area will result in minimal negative yet significant positive biological impacts. Atlantic white cedar usually grows in pure of near pure stands. Restoring applicable sites to historical conditions will once again result in a dramatic shift in species composition and forest structure. Tree species that are more suited to adequately drained soils will ultimately die off, if not harvested as part of the restoration process. The majority of hardwoods and pines that have occupied or dominated these sites following the most recent extraction of Atlantic white cedar timber and the installation of ditches will most likely be removed in order to allow for the germination of stored cedar seed and facilitate the growth and survival of seedlings. Converting the current mixed deciduous and coniferous forest to a conifer-dominated forest may displace certain avian and terrestrial species that are more adapted to drier mixed forest stands. The removal of hardwood and pine species will reduce the amount of available mast and may force those species that depend on hard and soft mast as a seasonal food source to disperse in search of food.

It is most likely that restoration will only be performed on a small scale, therefore, impacts will be minimal. If remnant cedars still occupy the site, the removal and subsequent control of all other trees will allow adequate light to reach the forest floor and facilitate the germination of viable seed stored in the duff layer of the soil, while effectively scarifying the soil in preparation for newly fallen seed. In cases where no cedars remain, soil disturbance during the harvest operations will expose the organic layer of the soil and created micro-relief, which will enhance survival of planted seedlings. The alterations in hydrology will decrease the ability of most trees' seeds to germinate due to longer periods of standing water. The increase in soil and surface water will enhance the breakdown of leaf litter, the accumulation of organic matter and, possibly, the restoration of sphagnum moss beds, which are essential factors in the storage and germination of Atlantic white cedar seed. The changes in surface water conditions (i.e., longer periods of flooding) will also displace certain ground dwelling species that cannot tolerate flooded conditions.

However, increased soil moisture will significantly improve the habitat suitability for amphibians. Although certain species of wildlife will be negatively impacted by the temporary loss of habitats, change in hydrology and ultimate cover type conversion, many species will end up benefitting from the restoration of Atlantic white cedar swamps. Mature cedar stands form dense tall canopies that are preferred by many species of birds including Neotropical migrants and FIDs. The dense canopy shades the forest floor resulting in a very sparse understory. The understory composition will likely be converted from a dense cover of *Smilax,* fetter bush and sweet pepper bush to a scattering of highbush blueberry, sweet bay magnolia and sweet pepper bush. Mature cedar stands also provide excellent shelter for all wildlife during severe weather.

D. Cropland Management

Background

Agriculture, more than any other human activity, has had a profound influence on North American waterfowl and other wildlife (Ringelman 1990). Sadly, many people relate only to the negative influences and environmental effects of historical agricultural practices: the conversion of grasslands and the clearing of forests, the drainage of wetlands, the use of pesticides, and the degradation of water and air quality due to siltation and dust, just to mention a few of the most obvious. However, the benefits of present-day croplands to waterfowl and other wildlife are significant and beneficial (Ringelman 1990).

Although the use of crops as a wildlife management technique is relatively new, the consumption of grain by waterfowl and other wildlife is not. Archaeologists tell us that Native Americans cleared creek and river bottoms and planted them in diverse crops 2500 years before the arrival of Europeans. Chroniclers of the Ponce de Leon, Narvaez, and DeSoto expeditions in the 16th century mention the extensive agriculture practiced by the southeastern tribes. Corn was a major crop, and when their fields in river bottoms were flooded, the corn that grew there and the ducks that visited them were brought together.

Writers of the late 17th century tell how ducks flocked to the rice fields of early settlers in South Carolina. David Doar, in "Rice and Rice Planting in the South Carolina Low Country," writes "After harvest, birds were left to glean the fields, and no one on a plantation dared molest them. After they had gotten through and the ducks came down, every field was flowed for them and though there were thousands of them in each field, they were as sacred as the white elephant, and neither the Negroes on the place nor the sons of the planter were bold enough to take a shot." The explanation lies in the fact that the waterfowl were reducing the volunteer and red rice the following year. Waterfowl and many other species of wildlife are opportunistic feeders, and have learned to adapt to changes in the environment around them. For example, many species of waterfowl, including, but not limited to, Canada geese (*Branta canadensis*), snow geese (*Chen caerulescens*), mallards (*Anas platyrhynchos*), northern pintails (*A. acuta*), and green-winged teal (*A. crecca*) have learned to capitalize on the abundant foods produced as human expansion and anthropogenic effects on native habitats changed the face of North America. In the last four centuries, much of our best wildlife habitat has been drained, filled, and cleared for development; ditched and channeled for drainage, flood control, and navigation projects; and polluted with heavy metals, chemicals, and pesticides. As agriculture has spread over the landscape, waterfowl migration routes and wintering areas have changed in response to these readily available high energy foods. Many species have developed such strong traditions in their use of certain croplands that many populations are now dependent upon agricultural foods for their winter survival (Ringelman 1990). The production of enough food to support winter populations remains one of the major problems in managing waterfowl today.

Cropland management has been an integral component of the development of Blackwater NWR since its establishment in 1933. In fact, its expanding and changing cropland management practices first brought Canada geese to the refuge. Every year for the past 65 years, the refuge has been encouraged to use cropland management to produce large quantities of highly nutritious foods on relatively small areas to help offset the loss of natural foods. The proof of the success of these cropland management programs is the diversity and abundance of the wildlife that now depend on them.

As waterfowl populations increased on the refuge in the late 1950s, particularly Atlantic population (AP) Canada geese, it is interesting to note that refuge staff began conducting all of the cropland management activities after 26 years of cooperative farming. Staff continued managing all cropland management activities until 1970, when there was a return to cooperative farming. This shift in management emphasis and direction coincided with a decade of significant marsh loss and natural habitat degradation, and waterfowl populations soon fell by as much as 70 percent or more. As historical waterfowl numbers continued to decline, refuge staff, in an effort to better meet the nutritional needs of wintering and migrating waterfowl and other wildlife, resumed "force account" management in 1989.

We base our cropland management on the principle "Wildlife First," rather than on primarily economical, historical, or sociological considerations. We are not proposing cropland management on the Chesapeake Islands.

Strategies for Blackwater NWR

A minimum of 420 acres of existing croplands, or 2 percent of the total refuge acreage, will be managed annually to achieve refuge purposes and wildlife management objectives.

Our first option will involve planting approximately 100 to 120 acres in corn and milo (sorghum), and approximately 300 acres in cool season grasses and forbs, consisting of ladino or crimson clover, annual rye grass, and winter wheat (over-seeded with buckwheat). A total of 100 percent of the crops will be left unharvested exclusively for wildlife utilization. Lands having Conservation Reserve Program or similar easements will be managed and maintained in accordance with NRCS guidelines and requirements. The planting of the corn and milo will be contracted each year on a competitive bid basis to a local farmer for a fixed price per acre, and will be left unharvested for use by waterfowl and other wildlife. Refuge staff, equipment, and operational dollars will be used to plant and cultivate the cool season grasses and forbs. Crop rotations will occur on a three to one ratio: three years in cool season grasses or forbs, followed by 1 year corn or milo, then back to grasses and forbs for another 3 years. The corn and milo acreage will not be plowed under in the spring, but will be left to succeed to warm season grasses after the annual rye grass, or crimson clover has died with the onset of warm weather. Only in the fall will these lands be cultivated and replanted to winter wheat or buckwheat, which later will be over-seeded back to ladino clover the following February (freezing in the seed rather than planting with normal tillage). The wheat will be allowed to mature in early summer to provide food for passerines and other wildlife.

If sufficient funding for the first option described above were not available, our second option would be to manage the cropland program with cooperating farmers. Please refer to the procedure described in the section on the Nanticoke protection area, below. Because of the nature of cooperative farming and the requirement for an economic incentive to obtain or retain cooperating farmers, the cropland management scheme and rotations would be significantly different than the first option. Most likely, 100 to 120 acres of corn or milo and 300 to 320 acres of soybeans would be planted annually with the refuge's share being the entire corn crop for wildlife use. The cooperating farmer would harvest all the soybeans as his 75-percent share and his incentive for planting and leaving the 100–120 acres of corn or milo unharvested to meet refuge purposes. While this option would save operational dollars, such a program would significantly reduce the amount of high protein clover crops and "green browse." To maintain similar benefits for wintering waterfowl and other wildlife, these important food resources would be replaced by top-seeding the harvested soybean fields with winter wheat or crimson clover in the fall, following soybean harvest. Because wintering waterfowl would totally consume these "green browse" crops, over-seeding would not be economically feasible for cooperating farmers and, thus, necessitate that the work be done "force account" by refuge staff.

Regardless of the option, filter strips will be planted and maintained by refuge staff around each of the field units. Runoff will be directed into existing impoundment systems prior to entering natural waterways. Only annual cropland management plans that utilize BMPs and integrated pest management will be developed and approved by NRCS prior to implementing actions. Conservation tillage and no-till farming practices will be widely utilized and preferred over conventional methods. While animal waste is readily available and will be considered as a substitute to inorganic sources of fertilizers, the Service's Wildlife Disease Lab has recommended against use of organic fertilizers due to the potential of disease transmission. All crops, to the greatest extent possible, will remain unharvested to be utilized by wintering waterfowl, Neotropical migrants (birds and butterflies), endangered species, and other wildlife. Standing crops, corn and milo, will only be manipulated (mowed or knocked down) after the waterfowl season to avoid conflicts with baiting laws. The unharvested corn crop will be aerially over seeded with annual rye grass or crimson clover to provide additional forage, soil stabilization, and improved water quality during winter. Cropland areas will be closed to public use to ensure undisturbed availability and utilization. A special effort will be made to plant corn and milo food plots in strips adjoining forest lands to provide supplemental food for Delmarva fox squirrels. Corn and milo fields will be set back from roadways by a minimum of 100 feet to minimize vehicular mortality to Delmarva fox squirrels that might be enticed to these food sources.

Annual monitoring programs will be implemented to evaluate the program's contributions to refuge purposes on both areas. Adaptive management techniques will be applied on all refuge lands.

E. Moist Soil Management

Background

Wetland habitats for waterfowl and other wildlife in the Atlantic Flyway have been significantly reduced in both quantity and quality due to adverse natural and human impacts over the last 200 years. An estimated 53 percent of the wetlands in the lower 48 states was lost between 1780 and 1980, and losses continue at the staggering rate of 260,000 acres per year (Frederickson and Reid 1987). Nearly half of that loss occurred in the Atlantic Flyway States as a result of urban sprawl, commercial development, dredging, road construction, agricultural drainage, and other factors.

In addition to experiencing similar external pressures during the past 70 years, waterfowl using Blackwater NWR have been adversely impacted by the loss of more than 7,000 acres of historically important wetlands due to sea-level rise, land subsidence, saltwater intrusion, and excessive herbivory. These threats have also adversely affected the wetlands in the Nanticoke protection area. The resulting impacts on breeding, migrating, and wintering waterfowl and other wildlife have been significant. Once, waterfowl and other wetland-dependent species had innumerable options to meet their needs in the annual cycle. Today, however, those options are very limited, making habitat enhancement and management more essential in meeting the demands of wildlife and people. Waterfowl are being forced to concentrate in fewer and smaller areas. Continued wetland losses increase the importance of sound management of the remaining wetlands and the need for the creation of new wetland habitats.

Human activities have modified the natural hydrology of most remaining wetlands in the conterminous United States, and such hydrologic alterations have frequently reduced wetland productivity. Therefore, the restoration of wetland functions and productivity often requires the development of water distribution and discharge systems designed to emulate natural hydrologic regimes.

In waterfowl conservation, it is becoming more difficult to maintain populations at a stable level. Thus, the need to maximize waterfowl management efforts (Whitman, et al. 1995). The possibility of acquiring substantial tracts of wetlands or other waterfowl habitat is decreasing. Moist soil management is a relatively new science that often is used to offset the loss of natural wetlands and provide their historical functions and productivity. In his early work in the Illinois River Valley, Dr. Frank Bellrose coined the term “moist soil” plants to refer to species that grew on exposed mudflats. Since then, wildlife managers have used the term “moist soil management” to refer to the management of man-made seasonally flooded impoundments. This very intensive management activity requires the construction of dikes or levees, the correct placement of water control structures, the construction of water delivery and discharge systems, and the active manipulation of water levels (1) create soil and water conditions for the germination of desirable plants, (2) control nuisance vegetation, (3) promote the production of invertebrates, and (4) make foods available for wetland-dependent wildlife.

Moist soil management has been an integral component of Blackwater NWR since the first dikes (levees) were constructed in the early 1940s. As the science of moist soil management improved, it encouraged the refuge to produce large quantities of highly nutritious foods on relatively small areas, to help offset the loss of foods in the degraded and quickly disappearing natural marshes. The proof of the success of our moist soil management program lies in the diversity and abundance of wildlife, particularly migratory birds, that now depend on its products. Within the Nanticoke protection area, only by a few private landowners and the Maryland Department of Natural Resources now practice moist soil management.

Strategies for Blackwater NWR

A minimum of 460 acres of moist soil management impoundments will be annually managed to achieve refuge purposes and wildlife management objectives. An additional 90 acres of existing prior converted croplands will be restored to this type of wetland management requiring an estimated two additional miles of levees, 10 more water control structures, and two and a half more miles of ditches and water distribution systems. It should be noted that additional cropland acreage is not being proposed for conversion to moist soil management because the remaining cropland acreage does not contain soils suited for this type of management, and because the conversion of the

remaining cropland will result in flooding neighboring private lands or create drainage problems on state and county highways.

Improvements in the existing 370 acres of moist soil management impoundments will stress fine tuning of water control; improved monitoring and research related to water chemistry and plant and invertebrate response; improvements and replacements of water control structures; reconfiguring dike slopes; maintaining water distribution canals and ditches; and providing individual water control for each unit. Two 8-inch vertical low lift pumps, one in each of the existing Pool 3 and Pool 5 systems, will be installed to better facilitate drawdown and flooding. Three additional water control structures will be installed between Pools 3A-3B, 3B-3C, and 5A-5B. In the Pool 4 system, the water control supply structure will be replaced and a new pumping and delivery station will be install. The main river dike around Pools 3 and 5 will be resloped and rip-rapped on the marsh side to prevent erosion.

Strategies for the Nanticoke protection area

It is currently impossible to determine the exact acreage that will be included in a moist soil management program, but it is certain that moist soil management will be desirable and practiced on new additions to the Refuge System. It is estimated that moist soil management will be practiced on 2 percent, or less, of the entire refuge acreage. Moist soil management impoundments will be constructed only in prior converted, existing agricultural fields where the proper soil, topography, and water supply exist to accommodate the infrastructures and management actions.

Specific management activities in all the moist soil impoundments, regardless of the specific refuge area, will attempt to mimic natural conditions with drawdowns in the spring and reflooding in the fall. Drawdowns will typically occur between mid-March and early June, depending on the wildlife objectives and plant and invertebrate response desired. Drawdowns will be staggered among moist soil management units. All drawdowns will be completed by mid-June and pool bottoms will be maintained as moist as conditions will allow to facilitate the germination, growth, and production of a wide diversity of emergent moist soil plants. (See chapter 3, “Affected Environment.”)

Water levels and chemistry will be monitored and recorded weekly during the growing season and biweekly during periods of flooding. Exact water level management protocols will be described in an Annual Water Management Program, and will consider bird migration phenology. Vegetation transects will be conducted between mid-June and mid-July, and again in early September, to determine success of vegetative response and required management action. When preferred vegetative response failed, and weeds such as cocklebur and fleabane became dominant, these areas will be disced and planted in milo or millet, rather than let these weeds mature and further contaminate the seed bed. Gradual reflooding, using rainfall runoff and the assistance of pumping from adjacent ponds and existing wells, where available, will occur in September. Optimum water depths of 6 to 12 inches will be maintained throughout the winter season.

The general objective will be to have 85 percent of the surface area of a moist soil management unit flooded to the optimum foraging depth at the peak of fall waterfowl migration. Water from the adjacent Blackwater and Nanticoke rivers will not be used for flooding and moist soil management purposes due to the high salinity that will kill the soil and the fresh water vegetation. Rejuvenation of the seed bed and control of “undesirable” species will be required. Occasionally, chemical control will be necessary to combat invasive species such as Phragmites and purple loosestrife, but mechanical control will be the preferred method of control.

Annual monitoring programs will be implemented and improved to evaluate the program’s contributions to refuge purpose(s). Additional research will be conducted to determine effects of the management activity on wildlife populations, water quality, and waterfowl energetics and nutritional needs. Adaptive management techniques will be applied.

F. Prescribed Fire Management

Background

In 2000, we completed NEPA compliance and planning, along with our Environmental Assessment (EA), of the wildfire management program for using prescribed burning as a tool in managing woodlands, croplands, and marshes on the Refuge Complex. Our Regional Director approved the FONSI and the final Fire Management Plan (FMP) on September 7, 2000, and September 15, 2000, respectively. Therefore, for the purposes of this CCP, the fire management program will be conducted as previously approved and described in the FMP.

Please note that the fire management program is presented in this context rather than as separate components or tools of the respective habitat management activities because of the tight parameters of how, when, and in what habitats we will use prescribed burning. A complete copy of the FMP and EA can be obtained upon request from Refuge Complex headquarters. The relevant consequences of those actions are described in detail in the original EA.

The Fire Management Plan preplanning began in January 1995. Its purpose was twofold: (1) to develop a FMP as a guide to fire management activities that complied with Department of Interior policy as set forth in 910 DM and Service guidance in 621 FW; and, (2) to address the role of fire in the stewardship of public lands. Operating under NEPA requirements to "use a systematic, interdisciplinary approach that will insure the integrated use of the natural and sdocial sciences in planning and in decision making," Service and Maryland DNR staff recommended and agreed upon an external, five-member, interdisciplinary team to independently and objectively review and evaluate the issues and develop the alternatives. Both professional and general public scoping meetings were held in July 1995, and 48 issues were identified and presented to the panel. The panel convened at Blackwater NWR on August 28, 1995 for briefings and site tours for two consecutive days. On August 30, 1995, the panel heard testimony from 22 expert witnesses, who gave presentations on various topics related to the issues identified during public scoping. On August 31, 1995, the panel deliberated on the issues with DNR and Service staff, and sequestered themselves on September 1, 1995, for final deliberations on the reasonable and prudent alternatives to be considered.

The Service, in cooperation with DNR, developed a Fire Management Plan (FMP) that would use a multiple-objective fire program on Blackwater NWR and Fishing Bay WMA. Under this program, the Service established, in conjunction with its annual prescribed burning and wildfire suppression programs, monitoring areas to document and evaluate vegetative responses to fire exclusion and to prescribed burning rotation intervals of 1 year, 3 years, and 10 years, in representative marsh and woodland habitats on Blackwater NWR and Fishing Bay WMA. This effort would identify which rotation would yield the most beneficial vegetative response and associated wildlife and public benefits so that such knowledge could be incorporated into fire management practices in order to best accomplish the following management objectives.

Nineteen Fire Management Objectives

1. Provide a level of wildland fire management that will result in the least cost plus net value change (cost efficient level) commensurate with resource management objectives and constraints.

2. Reduce wildfire impacts on all resource management activities. Reduce the threats associated with accumulations of hazardous fuel loads in marsh and woodland habitats, and with arson fires in the intermingled Federal, State, and private lands along the wildland–rural interface.

3. Assure that no disruption of service or adverse impacts on transportation and utility corridors occur from wildland fires.

4. Provide, maintain, enhance, and protect habitats for State and Federal endangered and threatened species, and species of special concern.

5. Provide, maintain, enhance, and protect feeding, resting, nesting, and brood habitat that meets the

requirements of migratory waterfowl, other migratory birds, and resident wildlife.

6. Maintain health and vigor of marsh vegetation, maintain current marshland acreage and species composition, and reduce brush invasion into marshlands.

7. Facilitate the control of resident and exotic furbearers.

8. Manage refuge woodlands to produce traditional forest habitat values: wood, water, wildlife, and recreation.

9. Encourage the regeneration and growth of desirable forest stands by disposal of logging slash, preparing sites for seeding and planting, reducing encroachment of undesirable species, and reducing understory competition.

10. Protect, maintain, and enhance refuge grasslands.

11. Encourage and maintain native herbaceous growth on abandoned cropland areas.

12. Provide diverse and abundant food crops in agricultural and moist soil management units to meet the nutritional requirements of various wildlife species.

13. Control Phragmites expansion.

14. Maintain current ecosystem diversity within the landscape context.

15. Contribute to the recovery and restoration of the Chesapeake Bay ecosystem's diversity and function.

16. Comply with State Air Quality Implementation Plans to protect public health and the environment.

17. Provide public trapping opportunities for furbearer population management, exotic species control, recreation, and economic benefit.

18. Serve as an outdoor laboratory for ecological research, study of management effects, and public education.

19. Protect valuable resources of international, regional, and local significance.

Reasonable alternatives, for the purposes of this evaluation process and planning effort, were alternatives that were justifiable, practical, and feasible from the technical, ecological, legal, policy, and economic standpoints.

The fire review panel proceeded with their work according to their charge and completed the evaluation process in April 1996. Their report was entitled "Technical Review of Fire Management Alternatives in the Blackwater National Wildlife Refuge and Adjacent Wetland Management Areas." In developing this report, panelists considered Blackwater NWR and Fishing Bay WMA as an ecological unit for the purposes of the evaluation and recommendations. In developing its recommended alternatives, the panel evaluated each of the possible burning regime's ability to meet refuge management purposes and objectives.

A joint-agency review of the panel's report was held in August 1996. The report was then distributed to those parties who had previously provided comments or expressed interest in the process. The report was also made available to the general public at the Dorchester County Library.

In January 1997, a public meeting was convened to discuss and accept comments on the panel's report. Parties in attendance were those who had provided comments at the earlier public meeting, presented information as expert witnesses to the panel, or expressed interest in attending. The consensus of those at the meeting was to accept the panel's recommendation.

Six Fire Management Regimes

The panel developed six alternative fire management regimes, including three that conform to the alternatives presented in the draft CCP and EA. See the table that follows for the acreage burned each year under each regime.

1. *Annual Fire Regime,* consistent with current management
2. *Multiple Objective Fire Regime,* consistent with our new management direction
3. *Annual Marsh plus Five-year Woodland Fire Regime*
4. *Annual and Five-year Fire Regime*
5. *Limited Suppression Fire Regime*, no active management
6. *Fire Suppression Regime*

Annual Fire Regime (Current Management: Species–specific Management)

This regime conforms to current management, the species-specific alternative in the draft CCP and EA. Under this regime, the Service will develop a FMP that will continue fire management as practiced up to 1997. Annual prescribed burning will be applied to approximately 3,000 acres (29 percent) of the marsh land on Blackwater NWR and approximately 10,000 acres (48 percent) of the marsh land on Fishing Bay WMA, for a total of 13,000 acres (42 percent). Approximately 110 acres (1 percent) of the refuge woodlands will be prescribed burned annually. Approximately 80 acres (9 percent) of refuge agricultural lands will also be burned.

One of the primary goals of burning marshes and woodlands will be to reduce fuel loading hazards and resultant wildfire dangers. Additional goals of the marsh burning program will be to maintain marsh health, encourage Olney three-square bulrush growth, reduce brush invasion in marshlands, assist in control of muskrat and nutria populations, and assist in control of common reed (*Phragmites australis*). In the woodlands, additional goals will be to enhance Delmarva fox squirrel habitat, increase habitat diversity (such as enhancing or developing grassland habitat), and reduce encroachment of undesirable species. In the agricultural burning program, the primary goal will be to facilitate tillage operations by reducing the vegetative litter. In all habitats, appropriate suppression actions will be taken on all wildfires based on firefighter and public safety, values at risk (property and natural resources), and cost of suppression.

This regime will define specific conditions under which burning will occur. The refuge will conduct marsh burns in the winter, normally between late-December and mid-March. Woodlands and agricultural lands will be burned during other seasons depending upon environmental conditions necessary to meet objectives. Wind directions will be chosen for a particular burn that will minimize fire escape potential and adverse impacts of smoke and particulate matter. Wind speeds will be selected to ensure that fire intensity will be commensurate with firefighter and public safety requirements and with burn and habitat objectives. Air temperature, relative humidity, and fuel and soil moisture will also be important factors of the burning prescription. Upper and lower limits of these factors will be set to produce fire intensity and behavior to meet burn objectives.

Multiple Objective Fire Regime (New Management Direction: Conservation Biology for Trust Species Diversity)

The Multiple Objective Fire Regime conforms to the new management direction. Under this regime, the Service and DNR will develop a FMP that provides guidance for wildfire suppression and prescribed burning. It will include a monitoring program to evaluate the effects of various burn rotations in all major vegetative community types. The panel recommended four fire frequency regimes with a representative range of years between burns. Based upon this recommendation, the following rotations will be implemented: (1) frequent fire regime (approximately 1-year burn rotation); (2) moderate fire regime (approximately 3-year burn rotation); (3) occasional fire regime (approximately 10-year burn rotation); and, (4) no fire regime (fire exclusion).

Burn monitoring areas will be established on both Blackwater NWR (three marsh sites and four woodland sites) and Fishing Bay WMA (three marsh sites). These areas are representative of marsh and woodland habitats that have been or could be subjected to prescribed burning. These 10 sites will total approximately 1,830 acres (1,380 acres of marsh land and 450 acres of woodlands). Within each site, four treatment areas will be established and assigned to one of the four burn rotations. These areas and treatment rotations will allow evaluation of the effects of varying intervals of prescribed burning application on various vegetative communities, to determine which rotation will yield the vegetative and wildlife responses that best meet management objectives.

This regime will result in a decrease of 1,035 acres in marsh habitat burned annually, and an increase of 450 acres of woodland burning over the current level. Wildfires will be aggressively suppressed in all areas where fires were occurring outside the planned rotation or burning outside prescription parameters. Appropriate suppression actions for all habitats and areas will be based on firefighter safety, values at risk (property and natural resources), and cost of suppression.

Selection of the sites identified for burn monitoring areas will be based upon extensive surveys of the refuge and Fishing Bay WMA. Consideration will be given to public safety, the likelihood for arson or wildfires, representative vegetation, burn logistics, trapper use, and suitability of the site for division into four treatment areas.

Primary marsh species of interest will be Olney three-square, saltmarsh hay, giant cordgrass, smooth cordgrass, saltgrass, black needlerush, and woody shrubs. Marsh vegetation characteristics will be monitored, such as species, frequency of occurrence, area of coverage, and areas of bare ground. Monitoring efforts will also include herbivore abundance, water salinities, and climatic conditions in order to reduce the influence of confounding variables.

Primary forest communities included in the burn rotations will be loblolly pine, loblolly pine–oak, loblolly pine–mixed hardwoods, and mixed hardwoods. Characteristics of the woodland community to be monitored will include species, diameter breast height (dbh), frequency of occurrence, percent coverage, height, and basal area. Overstory, shrub and herbaceous layers in the woodlands will be monitored. Based on long-term results, the refuge's burning program could be altered in the future to reflect the results of these evaluations in terms of the most beneficial fire regime to meet refuge management objectives and future planned increases in refuge acreage. Specific burning conditions similar to those in the Annual Fire Regime could be used.

Annual Marsh plus Five-year Woodland Fire Regime

The Service will develop a FMP that continues the current annual burning program on approximately 3,000 acres (29 percent) of refuge marsh lands and 10,000 acres (48 percent) of DNR marsh lands, for a combined total marsh burn acreage of 13,000 (42 percent). The Service also will begin using prescribed burning on 500 acres (4 percent) of woodlands on approximately a 5-year rotation interval, in addition to the 110 acres of woodlands burned under the current annual woodland burning program. Of all the regimes, this would be the greatest amount of woodland acres burned (610; 5 percent). The amount of agricultural lands subjected to annual burning will not change under this alternative. Appropriate wildfire suppression actions will be taken in all habitats relative to firefighter and public safety, resources at risk, and cost of suppression.

Annual and Five-year Fire Regime

The Service will develop a FMP that ensures frequent fire regimes are maintained in all vegetative community types. Under this regime, wildfire suppression and prescribed burning activities will be planned to ensure that all major public land vegetative community types have representative areas of approximately 1- and 5-year fire rotation intervals. Under this regime, there will be a reduction in annual marsh acreage that will be prescribed burned because part of the current annually burned acreage will be converted to a 5-year rotation.

Therefore, 12,310 acres (39 percent) of marsh will be burned annually, and 690 acres (2 percent) will be burned every 5 years. Also, 335 acres (3 percent) of woodlands will be burned on an annual basis, and 225 acres (2 percent) will be burned on a 5-year rotation. This will be the most woodland acreage burned annually under any of the regimes. The amount of agricultural lands subjected to annual burning will not change under this regime. Appropriate wildfire suppression actions will be taken in all habitats relative to firefighter and public safety, resources at risk, and costs of suppression.

Limited Suppression Fire Regime (No Action Management: Maximum Public Use with No Habitat Management)

The limited suppression fire regime conforms to no action management. The Service will develop a FMP that ensures appropriate wildfire suppression actions will be taken in all habitats relative to firefighter and public safety, resources at risk, and cost of suppression. Under this alternative, no prescribed burning will be used in any habitat. It is anticipated that aggressive suppression will be taken where public safety, property, or natural resource values are at risk, but less aggressive actions may be used where the fire is causing little human threat or ecological impact. Prescribed burning will be eliminated on 13,000 acres of marshlands, 110 acres of woodlands, and 80 acres of agricultural lands. It is anticipated that much more than the 13,000 acres of marsh and 110 acres of woodlands currently prescribed burned could be burned by wildfires.

Suppression Fire Regime

The Service will develop a FMP that ensures ALL wildfires will be controlled at a minimum size irrespective of values at risk or suppression cost, and no prescribed burnings will be used in any habitat. Under this regime, aggressive wildfire suppression will be taken on all fires regardless of the values at risk to ensure that a minimum of public land will be affected. We expect less average annual acreage will be burned, compared to the current program.

Table 4.4. Acres and percentage of habitat burned as prescribed in each fire regime

Fire Regime	***Habitat*** [a]														
	Marsh[b]					*Woodland*					*Agricultural*				
Rotation (Years)	1	3	5	10	None	1	3	5	10	None	1	3	5	10	None
Annual	13,000 42%	0	0	0	0	110 <1%	0	0	0	0	80 9%	0	0	0	0
Multiple Objective	11965 38%	345 1%	0	345 1%	345 1%	223 2%	113 <1%	0	113 <1%	113 <1%	80 9%	0	0	0	0
Annual Marsh + Five-year Woods	13,000 42%	0	0	0	0	110 <1%	0	500 4%	0	0	80 9%	0	0	0	0
Annual and Five-year	12,310 39%	0	690 2%	0	0	335 3%	0	225 2%	0	0	80 9%	0	0	0	0
Limited Suppressionc	0	0	0	0	13,000 42%	0	0	0	0	560 4%	0	0	0	0	0
Fire Suppression	0	0	0	0	13,000 42%	0	0	0	0	560 4%	0	0	0	0	0

[a]Percentages reflect acreage treated versus total acreage of same habitat available on Blackwater NWR and Fishing Bay WMA
[b]Marsh burns would be conducted on both Blackwater NWR and Fishing Bay WMA; woodland and agricultural burns would be conducted only on Blackwater NWR.
[c]Under the Limited Suppression regime, no prescribed burning would occur, but "limited suppression" of wildland fires could occur on a substantial portion of the 13,000 acres.

G. Land Protection Management

Background

Population growth, fragmentation, and other related land use changes must serve as an important backdrop in the Refuge Complex CCP. These forces ultimately affect the ability of the Service and its conservation partners to protect, enhance and restore the natural resources in the watershed. With respect to the value and importance of protecting land, the salient issue is what role should the Complex (and each refuge and division) play, as part of the emerging larger interconnected system of protected lands within the watershed. The concept embraces the fact that the Service alone cannot protect enough land in the Chesapeake Bay watershed to achieve the CCP objectives. Indeed, the fee-simple protection of lands within the protection areas is not the preferred conservation tool; protection of lands can occur without government ownership. Land and resource protection, in various forms and via a myriad of landowner assistance programs, will support the goals of the CCP and help achieve its ambitious landscape focus. The Service will rely heavily upon partners, including private landowners and existing government and NGO conservation programs.

We will design our programs to facilitate and encourage the overwhelming support for conservation that comes naturally to many landowners. America's farmers, ranchers, and other landowners know that if they exhaust the soil, abuse the land, or pollute its waters, their fields, pastures, streams, and woodlots will become less productive. They embrace conservation because it makes economic sense to them and, because they love their land. Many landowners have also worked diligently to attract wildlife and protect other natural resources. Whether because they enjoy hunting, fishing, or just watching and listening, most landowners are happy to share their land with wildlife. Indeed, the chance to have interesting plants and animals close by has long been one of the real joys of landownership.

Today, however, some of these landowners are wondering whether they should keep the welcome mat out for wildlife: not because they no longer enjoy wildlife, but because they fear that the presence of some animals, especially endangered species, could restrict what they can do with their land. This is unfortunately ironic. Most endangered species will need more and better habitats if they are to recover, and who better than America's landowners to provide those places. Yet if landowners believe that creating these habitats threatens their own future, they are not likely to do so. As a result, the refuges will work with other Service programs to ensure that landowners in the protection areas are informed and educated on options available to them with respect to the issue of endangered species, including the use of Safe Harbor agreements.

Similarly, many landowners have areas in need of habitat restoration and enhancement. For example, an individual landowner's decision to restore wetlands is as varied and complex as most other social decisions one makes. However, recent surveys clearly indicate that private landowners will restore and conserve wetlands if they believe that as good stewards of the land it is the right thing to do, if they can afford it, and if they can get some technical help (National Wetland Conservation Alliance 2001).

It is important to note that no single entity can effectively protect land in all cases and in all circumstances. A coalition effort has been developed to achieve long-term habitat protection for the Nanticoke and Blackwater River watersheds and the islands of the Chesapeake Bay, and share both funding and protection responsibilities. This plan considers the real possibility that other conservation-oriented agencies or organizations, including state resource agencies, either individually or through the combined efforts of a variety of agencies and groups, may provide long-term protection to those habitats susceptible to changes in land use without Service involvement. That is now the case in The Nature Conservancy, the Chesapeake Bay Foundation, the State of Maryland, and The Conservation Fund holding real property or perpetual easements. Similarly, other Service programs and USDA programs are in place, and offer financial and technical assistance in support of the land protection goals in this plan.

The coalition also may employ variety of land protection mechanisms. Those will include (1) conservation easements or restrictive easements may be protected in order to assure protection and use of land, where public and private uses are compatible; (2) delivery of landowner incentive programs; (3) fee-title protection; and, (4) cooperative management agreements, wherein a landowner, working with a public or private organization, voluntarily agrees to abide by an established set of guidelines for the long-term stewardship of his land.

In this final plan, the Service will take the lead in conserving and protecting internationally and nationally important wildlife populations and their habitats within the protection areas. Other land protection and habitat restoration and protection programs, administered by the USDA, The Nature Conservancy, The Conservation Fund, Partners In Flight, the State of Maryland, local land trusts, will contribute in collaborative and strategic partnerships as noted above.

H. Exotic, Invasive, or Injurious Species Management

Background

The Refuge Complex has set a goal of maintaining a healthy, diverse ecosystem with a full range of natural processes, natural community types, and the full spectrum of native plants and animals. That is an ambitious goal, because more than 200 species of rare, threatened, or endangered plants (G1-G5, S1-S3) and almost 70 species of rare, threatened, and endangered animals have been documented within the Refuge Complex by the Maryland and Delaware Natural Heritage Programs.

Exotic, invasive, and injurious species have, by definition, the potential to negatively affect the integrity of this system and, perhaps, the perpetuation of certain species. As Fofonoff, et al. (1998) observe, every established exotic species probably has some impact on native communities, but relatively few of these impacts are known, even on a qualitative basis. Of 202 introduced and cryptogenic species, 38 (19 percent) were considered to have probable impacts in the Chesapeake Bay. At least 15 of those 38 species are known to live within the Refuge Complex (see table 4.5, "Introduced and cryptogenic species reported to have impacts on native species in the Bay," below).

Executive Order No. 13112 (February 1999) directs all Federal agencies to prevent the introduction of invasive species; detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner, subject to funding, monitor invasive species populations accurately and reliably; provide for the restoration of native species and habitat conditions in ecosystems that have been invaded; and promote public education on invasive species and the means of addressing them. In addition, the Maryland Department of Agriculture maintains a list of noxious weeds that landowners must control.

Our legal mandate for extirpating or at least controlling exotic, invasive, and injurious species is clear. However, of the 38 species in table 4.5, the Refuge Complex has targeted only five: nutria (*Myocastor coypus*), resident Canada geese, mute swans, common reed (*Phragmites australis*), and purple loosestrife (*Lythrum salicaria*). In addition to those five aquatic-dependent organisms, populations of gypsy moth (*Lymantria dispar*) and two noxious weed species are aggressively monitored and controlled. These eight species are thought to constitute the most serious threat to maintaining natural biodiversity and meeting the other legal mandates imposed on the Refuge Complex (e.g., protecting endangered Delmarva fox squirrel habitat).

Nutria are indigenous to southern South America, and were introduced at Blackwater NWR in 1943. Their high population density, high reproductive rates, and unique foraging attributes are thought to have contributed to the loss of more than 7,000 acres of tidal marsh on the refuge during the past six decades. Nutria live within the Nanticoke protection area, but are not known to live on the Chesapeake Island Refuges. Refuge Complex staff completed the NEPA process to evaluate alternatives for controlling nutria in 2001. An individual EA was developed by USDA and the FONSI was signed in December 2001 (see "Furbearer Management," above).

The resident Canada goose population on Blackwater NWR has increased from an estimated 350 in 1989 to more than 5,000 in 2000. They have contributed to marsh loss, and to depredations of crops and moist soil plants that are grown for migratory waterfowl. Resident geese may also served as vectors for transmission of DVE, cryptosporidiosis, giardiasis, chlamydiosis, and West Nile virus. Resident geese occur throughout the Refuge Complex, but are centered on Blackwater NWR. Refuge Complex staff completed the NEPA process to evaluate alternatives for controlling resident Canada geese in 1999. An individual EA was developed, public input was solicited, and a Finding of No Significant Impact was signed by our Regional Director in February 2000.

Mute swans are exotic birds that escaped into the Chesapeake Bay in 1962 and currently number approximately 4,000 birds (Hindman 2000). Mute swans destroy beds of submerged aquatic vegetation and disrupt nesting colonial waterbirds. The Chesapeake Island Refuges harbor most of the mute swans on the Refuge Complex, but Blackwater NWR and the Nanticoke protection area sustain a few pairs. Mute swans are protected under Federal law, but are classified as "wetland game birds" under Maryland law (10–101). The Atlantic Flyway Council has adopted a policy advocating the control of the mute swan population in the Atlantic Flyway, and has urged state and Federal partners to institute effective management programs to control existing population levels while preventing the establishment of new problem areas. The USFWS Directorate specifically endorsed the recommendations of the Atlantic Flyway Council regarding mute swans.

Gypsy moths were brought to Massachusetts from Europe in 1869 to interbreed with silkworms. Gypsy moth larvae defoliate hardwoods, but may feed on several hundred different species of trees and shrubs. Blackwater NWR has been plagued with repeated infestations of gypsy moths, particularly in areas that have been salt-stressed. Defoliation, reduced mast production, and tree mortality threaten habitat used by endangered Delmarva fox squirrels. Gypsy moths occur on the Nanticoke protection area but population levels are not known. Gypsy moth infestation is not known to be an issue in the Chesapeake Island Refuges.

Phragmites has spread dramatically among both freshwater and brackish wetlands along the Atlantic Coast in recent decades. Phragmites seeds profusely and spreads vegetatively by a vigorous system of rhizomes and stolons. This invasion has changed basic ecosystem processes and caused replacement of diverse wetland plant communities by monotypic Phragmites stands. Dense Phragmites stands decrease native biodiversity and impact the quality of wetland habitat, particularly for waterfowl. Phragmites is prevalent throughout tidal marshes on the Refuge Complex. At present, convincing and decisive evidence for the status of Phragmites as native, introduced, or both, is not available (Blossey and McCauley 2000).

Purple loosestrife is an exotic plant that aggressively invades wetland communities. It was first observed on Blackwater NWR in 1996, and spot treatments appear to have contained and, perhaps, eradicated it. Purple loosestrife occurs within the Nanticoke protection area, but its distribution is not known; it is not known to occur on the Chesapeake Island Refuges.

Johnson grass (*Sorghum halepense*) forms weedy hybrids with cultivated sorghum (*S. bicolor*). Both Johnson grass and Canadian thistle (*Cirsium arvense*) are poisonous to mammals, and are listed as noxious weeds by the Maryland Department of Agriculture. Both occur within the moist soil impoundments and croplands on Blackwater NWR; their distribution elsewhere on the Refuge Complex is not known.

This plan offers our preferred management program, with more aggressive control of all eight species, including an Integrated Wildlife Damage Management Plan for resident Canada geese, the eradication of loosestrife, more intensive nutria control, surveys for other forest insect pests, and the control of Phragmites in the natural marsh ecosystem.

Management Strategies

We will control nutria by implementing the recommendations of the Nutria Damage Reduction Pilot Program, a 3-year study to develop control techniques and evaluate the demographic and reproductive response of nutria to reduced population densities. We will also continue the nutria trapper rebate program at Blackwater NWR.

Resident Canada goose populations and depredation will be controlled by implementing the Integrated Wildlife Damage Management Plan (IWDMP), approved December 1999. This program will include nonlethal scare techniques, such as pyrotechnics, propane cannons, eagle effigies, reflective tape, balloons, and flags. Geese will also be excluded from certain areas with the use of perimeter fencing. Lethal components of this program will include nest and egg destruction, live capture with humane euthanasia by certified processors, and selective killing of individuals to reinforce nonlethal methods.

Mute swan control will comply with the Atlantic Flyway Council's recommendations. Also, these recommendations will be modified by the findings of the Maryland DNR-sponsored Mute Swan Task Force, current legislation, and actions to authorize the taking of eggs and adults.

Table 4.5. Introduced and cryptogenic species reported to have impacts on native species in the Bay[1]

Species	*Common name*	*Impact*[2]	*Abundance*
Regular residents, definite-probable			
Haplosporidium nelsoni	MSX	P,C,HC	abundant
Hydrilla verticillata	hydrilla	C,HC,F/P	abundant
Iris pseudacorus	yellow iris	C,HC,T	common
Murdannia keisak	Asian dewflower	C,F/P	abundant
Alternanthera philoxeroides	alligatorweed	C	rare
Lythrum salicaria	purple loosestrife	C,HC,F/P,X	common
Myriophyllum spicatum	Eurasian watermilfoil	C,F/P,HC	abundant
Trapa natans	water chestnut	C,HC	rare
Cordylophora caspia	freshwater hydroid	C,HC	abundant
Garveia fanciscana	rope grass	C,P,HC,F/P	abundant
Bithynia tentaculata	faucet snail	CC,F/P	common
Corbicula fluminea	Asian clam	H,F/P,C,HC	abundant
Rangia cuneata	wedge clam	F/P,C,HC	abundant
Loxothylacus panopaie	parasitic barnacle	P	abundant
Orconectes virilis	crayfish	C	abundant
Drosoma petenense	threadfin shad	C	common
Cypinus carpio	common carp	P,H,bioturbation	abundant
Ictalurus punctatus	channel catfish	P,H	common
Lepomis macrochirus	bluegill	H,C	abundant
Micropterus dolomieu	smallmouth bass	C,P	rare
Micropterus salmoides	largemouth bass	C,P	common
Morone saxatilisXchrysops	hybrid striped bass	C,X,P	rare
Anas platyrhynchos	mallard	C,H	abundant
Branta canadensis	Canada goose	C,HC	common
Cygnus olor	mute swan	H,C,HC	common
Myocastor coypus	nutria	C,H,HC	abundant
Rattus norvegicus	Norway rat	C,P	bundant
Regular residents, cryptogenic			
Perkinsus marinus	dermo	P,C,HC	abundant
Phragmites australis	common reed	C,HC,F/P	abundant
Typha angustifolia	narrow-leaved cattail	X,C,HC	abundant
Nematostella vectensis	starlet sea anemone	P,F/P	unknown
Victorella pavida	cushion moss bryozoan	HC,C,F/P	abundant
Ischadium recurvum	hooked mussel	C	abundant
Botryllus schlosseri	golden star tunicate	HC,C,F/P,T	common
Occasional residents, definite-probable			
Polygonum perfoliatum	mile-a-minute vine	HC,C,F/P	common
Lampsilis cardium	pocketbook mussel	CC/H	unknown
Cervus nippon	sika deer	H,C	abundant
Equus caballus	pony, horse	H,HC	rare

[1]Fofonoff, et al. 1998
[2]P=parasitism, C=competition, HC=habitat change, F/P = food/prey, T=toxicity, X=hybridization

Gypsy moth populations will be controlled using Integrated Pest Management techniques on the Refuge Complex. The IPM program will include coordination with the U.S. Forest Service to monitor gypsy moth populations and recommend treatments of Btk or Gypcheck. Those efforts will be extended to forested lands protected on the Nanticoke protection area. This plan also includes silvicultural prescriptions, identified in the draft Forest Management Plan, to reduce the susceptibility of trees to gypsy moth and other forest pest infestations by improving forest health and vigor.

Phragmites will be controlled over more extensive areas of the tidal marsh, contingent on funding. The most widespread and successful approach is the application of glyphosate late in the growing season, followed by prescribed burning or mechanical removal of dead stalks. Additionally, biological control agents specific for Phragmites, which are being investigated at Cornell University, will be considered for use if feasible. Specific strategies to control Phragmites will be developed as part of the Marsh Management Program.

Purple loosestrife, Johnson grass, and Canadian thistle will be controlled with the spot application of glyphosate. These three invasive and injurious species are associated with the moist soil management units and croplands. Constant vigilance is required on the part of refuge staff to maintain the advantage of early detection. It may be necessary to consider the use of biological control agents developed by the Plant Protection Section (Maryland Department of Agriculture). Of the three species, agents have only been identified for Canadian thistle; these include several insects (*Cassida rubiginosa*, *Ceutorhynchus litura*, *Cleonis piger*, *Rhinocyllus conicus*, *Urophora cardui*, *Larinus planus*) and two diseases (*Puccinia punctiformis*, *Pseudomonas syringae* pv. *tagetis*). The refuge will continue the current policy, established in 1989, of no insecticides in the farming program. In addition, surveys for exotic flora will be conducted (see "Inventory, Monitoring, and Research"). As previously noted, EAs and FONSIs were approved for the existing Fire Management Plan (Sep 2000,) the Integrated Wildlife Damage Management Plan for Resident Canada Geese (Dec 1999), and the Nutria Damage Reduction Pilot Program (Dec 2001).

More than eight exotic, invasive, and injurious species could be controlled within the Refuge Complex. At issue is the extent to which the Refuge Complex should go. Some species are exotic and may be somewhat invasive, such as Japanese honeysuckle (*Lonicera japonica*), but may not directly impact existing refuge management objectives. Others, such as many roadside weeds (e.g., yarrow [*Achillea millefolium*]), are so well-established across North America that control within refuge boundaries will be a futile gesture. However, if certain communities are identified as rare in the Nanticoke protection area, for example, should the Refuge Complex seek to eradicate non-indigenous species that infringe on those communities? An exotic species needs to be perceived as invasive or otherwise injurious before warranting consideration for management. This is pragmatic, but not necessarily consistent with concerns for maintaining and promoting the diversity of native biota. However, until the distribution of other exotic species and their effects are better understood, and additional funding becomes available, the control of other exotic species will not be considered.

I. Supplemental Nest Structure Management

Background

Since 1973, Blackwater and the Chesapeake Island Refuges have provided artificial nest structures for several avifauna to supplement naturally occurring availability. All of the targeted species were considered species in need of conservation for various reasons (their global TNC and regional PIF rankings are in parentheses): eastern bluebird (G5,14), wood duck (G5,15), barn owl (G5, 20), osprey (G5, 15), American black duck (G5, 20), prothonotary warbler (G5, 22), and peregrine falcon (G4, 16). The eastern bluebird, wood duck, barn owl, and prothonotary warbler are cavity nesters; nest boxes are an effective management tool for increasing potential nest sites. Peregrine falcons and ospreys declined in number and distribution primarily due to organochlorine use in the 1950s and 1960s; nest platforms are considered critical in reintroduction and recovery efforts. American black ducks on the Chesapeake Island Refuges nest in low-lying black needlerush marshes, which are subject to tidal and storm-induced inundation; floating nest platforms are considered a feasible but unproven option for improving production.

Now that populations of these species have recovered in recent years, the efficacy of continuing this program is being questioned for a number of reasons: (1) these artificial structures require annual maintenance and periodic

monitoring; if not monitored and controlled, many of the nest boxes will harbor and produce exotic species such as house sparrows and European starlings; (2) most of the wood duck boxes on Blackwater NWR were erected as duplexes; however, recent research indicates that the clustering of nest boxes causes high rates of brood parasitism and can actually depress nesting success (Semel, et al. 1990, Semel and Sherman 1995); (3) regional translocations of peregrine falcons are now recommended only for the Maryland and Virginia Piedmont which, unlike the Delmarva Peninsula, are considered part of their former breeding range; (4) although natural nesting sites for ospreys are limited on some of the island units, this is not the case for most of the Refuge Complex; furthermore, ospreys will readily nest on other structures such as channel markers, towers, and bridge abutments.

Management Strategies

The Refuge Complex will evaluate the efficacy of maintaining, downsizing, or expanding the supplemental nest structure program. Specifically, the contribution of the various structures to desired local, regional, and national population goals will be compared with the program costs. Novel placement of nest structures will be considered; e.g., placing nest boxes for prothonotary warblers and wood ducks on the same pole in appropriate habitat. Part of this evaluation will be an assessment of the availability of natural nest sites on the Refuge Complex, including the recognition that the Refuge Complex maintains more than 5,000 acres of palustrine forested wetlands, and that tree mortality due to periodic saltwater intrusion and repeated gypsy moth defoliation has provided significant acreages of natural nest trees (i.e., snags) on the Blackwater NWR and Nanticoke protection area. Silvicultural treatments (including contract sales and TSI) will specifically retain from two to five snags of at least 12" DBH per acre to ensure a good distribution of natural cavities on the refuge (see Forest Management). Also, the use of floating nest platforms to increase American black duck production, particularly on the Chesapeake Island Refuges, will be field-tested as part of the American Black Duck Initiative.

J. Furbearer Management

Background

Since its establishment in 1933, Blackwater NWR has lost nearly 7,000 acres of wetlands. That loss has occurred primarily in the mesohaline Olney three-square marsh at the confluence of the Little Blackwater and Blackwater rivers, but now is also progressing downstream. Similarly, the Nanticoke estuary has lost 122 acres of marsh annually over the same time interval. Unlike the Blackwater system, much of that loss has occurred in submerged upland marshes, with rates increasing down-estuary (Kearney, et al. 1988). Several scientific studies since the 1970s have focused on these unusually high rates of wetland loss, which may be the result of several confounding factors, including sea-level rise, land subsidence, saltwater intrusion, severely modified hydrology, and excessive herbivory. Although several species have reached population levels high enough to cause marsh degradation, e.g., muskrats (*Ondatra zibethica*) in the 1930s, wintering Canada geese in the 1960s, and resident Canada geese in the 1990s, none have been as persistent a problem as the introduced nutria (*Myocastor coypus*).

Nutria are South American semi-aquatic rodents similar to beavers that were first introduced in the United States in 1899 (Willner, et al. 1979). Nutria now are established in 14 states, and sightings have been reported in 40 states (LeBlanc 1994; Hess, et al. 1997). Nutria introduction into the Chesapeake Bay occurred in 1943 with attempts to stimulate the local fur farming economy (Maryland DNR 1997). Nutria introduction efforts included the establishment of an experimental fur production facility on Blackwater NWR (Meanley 1978). Nutria escaped from the facility and were released by private entrepreneurial trappers. The first known take in the wild at Blackwater NWR was in 1952. By 1961, nutria were regularly being trapped on the refuge.

Nutria are large, surface-feeding herbivores that can be extremely destructive to marsh vegetation. These powerful animals forage directly on the vegetative root mat, leaving the marsh pitted with digging sites and fragmented with deep swim canals. A 3-year study of 342 fixed vegetative plots within 57 quarter-acre experimental units clearly demonstrated that “eatouts” into the root mass by nutria are degrading the ability of the marsh to maintain itself (Mike Haramis, USGS–BRD). In the face of rising sea levels, nutria damage is particularly problematic, because it accelerates the erosion associated with tidal currents and wave action. The situation is extremely delicate within the tidal marshes of the Blackwater River, because much of its marsh is underlain by a layer of fluid mud that is easily

washed away once the vegetation becomes fragmented. The cumulative result of an overabundance of nutria and rising sea level at Blackwater NWR has been a rapid conversion of emergent marsh to open water.

Limited mark-and-recapture estimates of tagged nutria have suggested that population densities range from 2.6–10.3 nutria per acre, with estimates as high as 50,000 nutria on Blackwater NWR (B. Giese, pers. comm.). Nutria are extremely prolific, reproducing throughout the year and having two to three litters annually (Brown 1975, Willner, et al. 1979). On average, nutria have five young, but a female may have as many as 13 offspring per litter (Nowak 1991). Nutria weigh up to 18 pounds, which is 5 to 10 times the size of native muskrats. Nutria are also a highly invasive species, partly because no natural predators are present. There are confirmed reports of nutria on the Eastern Shore from the Chesapeake Bay Bridge to Ocean City, Maryland and south to the Virginia border. On the Western Shore, nutria are in the Patuxent and Potomac Rivers, and to the northeast in Delaware (R. Colona, pers. comm., MD DNR).

The jurisdiction for managing most resident wildlife rests with the MDNR, which has the authority to request other agencies' assistance in achieving management objectives. Our authority to remove nutria from Refuge System property stems from Executive Order No. 13112 (see "Exotic, Invasive, and Injurious Species") and our authority to assist the State of Maryland from Public Law 105–322. Nutria are managed as furbearers with no closed season in Maryland, and have limited economic importance in some localities. Currently, MDNR manages nutria as a furbearer, but nutria are legally defined as an unprotected species (COMAR §§ 10–101(s)). If necessary, the MDNR has the option and authority to reduce restrictions on trapping, snaring, or hunting, to provide more harvest opportunities for sportsmen and sportswomen. Although there is no closed season for nutria in Maryland, most private trappers and hunters are not able to provide year-round, site-specific nutria damage reduction. However, that option remains open to entities experiencing damage or the threat of damage.

The Marsh Management Plan details strategies to deal with the conservation and recovery of the existing marsh. Part of that plan includes the control of nutria and muskrat populations as a strategy to prevent excessive herbivory in the marsh. It will continue permitted muskrat trapping and the monetary rebate for nutria, allow only incidental take of other furbearers, and implement the Nutria Damage Reduction Pilot Program.

Management Strategies

Although nutria were introduced to support the fur industry, private fur trappers have not kept pace with this invasive animal's ability to reproduce. From a fur trapper's perspective, nutria are less valuable than other furbearers such as the native muskrat, because only a portion of the pelt is usable, the quality of nutria fur is inferior, nutria pelts are time-consuming to process, and nutria are heavier to carry out across the marsh than muskrats. In addition, fur markets and the profits from nutria pelts have been subject to fluctuations for a variety of factors, such as the animal rights movement, fashion trends, U.S. exchange rates, and the political and economic trends in consumer nations (Maryland DNR 1997).

Consequently, Blackwater NWR initiated a nutria rebate program in 1990. That program and incidental take by refuge staff have removed almost 58,000 nutria from the refuge in the past15 years. However, that number likely represents a very small fraction of the population. Limited mark-and-recapture estimates of tagged individuals suggest that populations have been as high as 50,000 nutria on the refuge. Using those values as averages, less than 8 percent of the nutria population has been removed annually by this program on the refuge. The difficulty in controlling nutria populations has been demonstrated at Tudor Farms, which is a privately owned, 7,000-acre hunting preserve in Dorchester County. Population density estimates range from 5–8 nutria per acre of marsh (L. Ras, unpubl. data). Despite an annual harvest of 4,000–5,000 nutria per year, the nutria population appears to be unaffected and signs of excessive herbivory are prevalent. Therefore, a systematic and well organized nutria damage reduction and marsh recovery program is needed to curtail vital marsh loss and recover habitats and ecosystems vital to native wildlife populations.

The most viable furbearer management program will ideally encompass the integration of regulated trapping and hunting of furbearer species, habitat management, population monitoring and harvest analyses, research on furbearer ecology, and public education for achievement of an overall goal of conserving furbearer populations (and other faunal populations), their ecological roles, and their habitats in the public interest. Furthermore, such a fully integrated program is attained not only by the planned, coordinated, and complementary use of various adaptive

management programs within the refuge and surrounding lands, but also in concert with the statewide furbearer management strategy carefully designed and implemented by Maryland DNR.

The feasibility of nutria population control or eradication will be studied by completing the Nutria Damage Reduction Pilot Program. This is a 3-year pilot project to develop control techniques, evaluate demographic and reproductive responses of nutria to reduced population densities, and demonstrate marsh restoration techniques. The Nutria Partnership of 27 organizations was formed in 1997 to deal with this problem. Partners include Blackwater NWR (USFWS), the Chesapeake Bay Field Office (USFWS), Patuxent Wildlife Research Center (USGS–BRD), MD Cooperative Fish and Wildlife Research Unit (USGS–BRD), MD Department of Natural Resources, MD Dept of the Environment, UM–ES, UM–College Park, Tudor Farms, Ducks Unlimited, National Fish and Wildlife Foundations, Friends of Blackwater, the American Aquarium and Zoological Association, the MD Fur Trappers Assoc., the MD and DE Chapter of the Wildlife Society, and the Salisbury Zoo. A pre-decisional EA was drafted in March 2001 and the FONSI was signed in December 2001.

Under this plan, recommendations resulting from the three-year pilot program will subsequently be implemented. Additionally, muskrat trapping and the nutria trapper rebate program at Blackwater NWR will be continued and, perhaps, modified to reflect recommendations forthcoming from the Nutria Damage Reduction Pilot Program. Furbearers other than nutria and muskrats will be taken only incidentally under this plan.

Control Methods Considered But Dismissed

Harassment

Harassment has generally proven ineffective in resolving aquatic rodent damage problems (Jackson and Decker 1993). Also, the removal of food supplies to discourage nutria activity is generally not feasible nor ecologically desirable.

Repellents

No repellents are registered for nutria or muskrat damage reduction at this time.

Contraception

A review of research evaluating chemically and surgically induced reproductive inhibition as a method for controlling nuisance aquatic rodents is contained in Novak (1987b). Although these methods were effective in reducing beaver reproduction by up to 50 percent, the methods were not practical, or were too expensive for large-scale application.

Under this strategy, nutria and muskrats would be surgically sterilized or contraceptives administered to limit their ability to produce offspring. However, at present, no chemical or biological contraceptive agents for nutria are registered by the EPA, FDA, or MDA, and the use of immunocontraceptives is still under research. A nutria contraceptive, chemosterilant, or immunocontraceptive, if delivered to enough individuals, could temporarily suppress local breeding populations by inhibiting reproduction. The reduction of local populations would result from natural mortality combined with reduced fecundity. No nutria would be killed directly with this method; however, treated and untreated nutria will continue to cause damage. Nutria populations outside the treatment area would probably be unaffected.

Contraceptive measures for mammals can be grouped into four categories: surgical sterilization, oral contraception, hormone implantation, and immunocontraception (the use of contraceptive vaccines). These techniques would require that nutria receive either single, multiple, or possibly daily treatment to successfully prevent conception. The use of this method would be subject to approval by Federal and state agencies. This strategy was not considered in detail because: (1) it would take many years of implementation before the nutria population would decline, and therefore, damage would continue at the present unacceptable levels for years; (2) surgical sterilization would have to be conducted by licensed veterinarians, would therefore be extremely expensive and labor-intensive; (3) it is difficult to effectively live trap or chemically capture the number of nutria that would need to be sterilized to

effect an eventual decline in the population over large areas; and, (4) no chemical or biological agents for sterilizing nutria have been approved for use by state and Federal regulatory authorities.

Fumigants

Several fumigants are registered for controlling burrowing rodents, but none are registered for use against nutria or muskrats; in marsh habitat, nutria generally do not burrow extensively. Some fumigants, such as aluminum phosphide and carbon monoxide, may have potential as nutria control agents, but their efficacy has not been scientifically demonstrated. In addition, these methods are neither practical nor legal, because they are not registered for this purpose.

Bounties

Bounties were not considered because they are not generally effective in reducing damage and have not been found effective in reducing populations, circumstances surrounding the take of animals are largely unregulated, the Service does not have the authority to establish a bounty program, and Maryland law prohibits the MDNR from paying bounties (COMAR §§ 0–107).

Nonlethal management and relocation

Nonlethal damage management and the relocation of native species may be appropriate in some situations with some species (e.g., if the problem species' population is at very low levels, there is a suitable relocation site, and, the additional funding required for relocation can be obtained.) However, nutria are an exotic, invasive species that competes with native fauna. Executive Order No. 13112 stipulates that each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions." In addition, relocation would be illegal under Maryland statute (COMAR §§ 08.03., 09.03).

K. Inventory, Monitoring, and Research Management

Background

The Refuge Complex has strategically protected land, intentionally managed habitats, and experienced significant natural changes in habitats. Some species have been extirpated (e.g., red-cockaded woodpecker) and others have been introduced (e.g., Sika deer, purple loosestrife). Not only does the Refuge Complex lack a good historical benchmark from which to reference these changes in the landscape and biota, it also does not have adequate data to determine existing floral and faunal distributions. Blackwater NWR has supported several species-specific surveys over the years to monitor trends of managed populations, but the effects of management on nontarget species are almost unknown.

The lack of scientific data about wildlife populations, their habitats, and the effects of management actions has been a persistent lament among both managers and researchers for decades. This is particularly true today, when managers and biologists are tasked with developing adaptive management programs, when habitat-specific rather than species-specific management is being emphasized, when promoting biodiversity has become an almost universal management goal, when long-term ecological monitoring is considered a critical component by the scientific community, and when the occurrence of rare species is both of public and regulatory interest.

In general, any inventory, monitoring, and research program serves several critical functions. A comprehensive biological inventory is the first step in identifying nontarget species that could be affected by ongoing management programs. It will also help identify species, such as those that are rare, threatened, or endangered, that should be a management focus. Subsequent population monitoring is what creates opportunities to change a management program to more optimally affect the target population (i.e., adaptive management), to evaluate the effects of a

management program on nontarget species, and to promote early detection of environmental degradation. Applied research can focus existing management and identify new management needs by helping us understand underlying ecological functions and processes, and species-habitat relationships. Rarely will implementing these program components have a negative effect on the physical or biological environment. However, the failure to implement these programs may result in lost opportunities to more effectively manage target populations, to more positively affect nontarget species, and to detect early evidence of invasive species, insect outbreaks, contaminants, or other signs of environmental degradation.

Based on those concerns, this plan will substantially increase monitoring and research efforts by implementing a Refuge Complex-wide inventory and monitoring (I&M) program, by aggressively pursuing funds to support new research efforts (particularly to support tasks identified in endangered species recovery plans), and by implementing new monitoring programs to support island and marsh restoration, forest management, and moist soil impoundment and cropland management (i.e., adaptive management).

Management Strategies

The Refuge Complex will address four specific information gaps: (1) a baseline inventory to determine the occurrence and spatial distribution of flora and selected fauna; (2) a long-term monitoring program to determine temporal trends in selected flora and fauna; (3) an adaptive management program to guide significant habitat and population management actions (this is most salient for the moist soil and cropland, prescribed burning, marsh restoration, and forest management programs); and (4) detailed research into habitat–species relationships (some of the more obvious relationships to investigate are waterfowl use of refuge habitats and habitat requirements for T&E and FID species).

The Refuge Complex will continue its present inventory and monitoring, and will include annual surveys for anurans (North American Amphibian Monitoring Program protocols), saltmarsh sparrow (R5 protocols), marshbirds (R5 protocols), colonial waterbirds (MD-DNR protocols), and shorebird populations in the marsh, all to be conducted by Refuge Complex staff. A comprehensive, Refuge Complex-wide I&M Program will be implemented on a 500m-interval grid system for selected flora and fauna. Forest stand inventory (particularly of regenerated sites and newly protected lands) will continue. MAPS (Monitoring Avian Production and Survivorship) stations will be established on Blackwater NWR to monitor the avian response to implementation of the Forest Management Plan. The water quality monitoring program will be expanded to included real-time sensors, permanent sampling sites, and a permanent tide gauge on the Little Blackwater River. In addition, one-time surveys of tiger beetles and migrant Neotropical birds and lepidopterans on the Chesapeake Island Refuges will be contracted. Similarly, one-time surveys of anadromous fish in the Nanticoke and Blackwater Rivers will be contracted.

A number of research projects will be initiated to facilitate adaptive management. As part of the Forest Management Program, funding will be sought for several studies including the effects of prescribed woodland fire on DFS and FIDs, the effects of selective harvesting techniques on DFS and FIDS, and the effects of TSI on DFS and FIDS. As part of the Marsh and Island Management Programs, several studies will be implemented including wetland mapping in the Chesapeake Bay watershed; surficial processes of sediment and contaminant transport, deposition, sea-level rise, and sustainability of the Blackwater NWR; and biological monitoring associated with restoration projects. As part of the Fire Management Plan, the effects of the four fire prescriptions on selected wildlife will be evaluated. As part of the Integrated Wildlife Damage Management Plan, the use of goose repellants (FlightControl®) to reduce crop depredation will be tested. As part of a larger Region 5 initiative, Blackwater NWR will participate in a study of the effects of moist soil drawdown on shorebird use, benthic invertebrates, and vegetation. As part of the American Black Duck Initiative, funding will be sought to evaluate predator control and the use of floating nest platforms on the Chesapeake Island Refuges, and to develop cooperative research to determine the movements and nesting success of black duck hens Refuge Complex-wide.

Other research will be developed to fill information gaps. In particular, it will include studies of the genetics and continental movement the lesser snow goose population at Blackwater NWR, and the effects of Animal Feed Operations on Blackwater and Nanticoke protection area. Other contaminant assessments may be necessary in the Nanticoke watershed. Additionally, funding for research needs specifically identified in recovery plans for Federal-listed species will be more aggressively pursued.

Last, a Geographic Information System will be developed for the Refuge Complex. As base layers, that GIS will include DOQQs, DRGs, DLGs, vegetation classifications under the National Wetland Inventory and National Vegetation Classification System, and USDA soil types. Hyperspectral imagery will be used to delineate wetland communities (including invasive Phragmites and purple loosestrife distribution). LIDAR will be considered for the development of bathymetric and elevational contours, canopy height, or Digital Elevation Models. Geo-referenced data collected as part of the I&M program, and obtained from the MD DNR Heritage Program, will be maintained in the GIS.

L. Islands Management

Background

Erosion control and habitat restoration is a major component of this plan. The activities and management strategies will apply to the Chesapeake Island Refuges.

Erosion is the overriding environmental factor affecting the islands. Their shorelines, particularly the ones facing west, are receding at a rate of 8–12 feet per year. At that rate, most of the land and habitat types that compose the Island Refuges will be lost in the next 100 years. SAV beds, which are buffered by the islands against wave action, will also be lost. With the exception of aquatic resources (e.g., fish, benthics, and aquatic invertebrates), all other faunal species will be displaced.

Erosion control and habitat restoration are proposed in partnership with the U.S. Army Corps of Engineers, constructing stone segmented breakwaters and filling shallow waters to restore habitat such as wetlands, beaches, intertidal flats, uplands, and dunes. We will develop Environmental Impact Statements or Environmental Assessments on a project-by-project basis.

M. Hunting Management

Background

In the 1930s, most of Dorchester County was rural. Hunting was a means of providing food for the table, as well as an accepted, popular form of recreation. The local populace hunted on their own land, and allowed others to hunt on their land. Blackwater NWR was considered a sanctuary for wildlife, and protected from poachers. Few visitors came to the refuge.

A 1949 amendment to the Duck Stamp Act permitted hunting on 25 percent of the land purchased for the Refuge System with Duck Stamp funds, but Blackwater NWR remained closed to hunting. [Note: Later amendments authorized hunting on up to 40 percent of the land purchased.] After World War II, Americans traveled the Nation's back roads and discovered their national wildlife refuges. Interest developed in using refuges for recreation other than hunting. Although most wanted to share with their families the sights and sounds of wildlife and the wonders of the living world, many also wanted to use their refuges to sail, swim, camp, fish, hike, jog, water ski, ride horses, sunbathe, bicycle, and rock-climb. Guidance in the first Refuge Manual (1943) left the door open to public uses for the cause of building public support, but conflicts between wildlife and public uses could be foreseen. In the 1957 Refuge Manual, guidance on how to decide which public uses to allow hinted at a wildlife-first priority, but sent mixed signals.

The Refuge Recreation Act of 1962 and the Refuge Administration Act of 1966 placed into law the concept that refuges would be closed to all recreation uses, until the refuge managers could determine that a proposed use was compatible with the purpose for establishing the refuge, and that sufficient funds were available to administer those uses. Usually, these determinations were made locally and, in many cases, were based on local pressures and interests. The compatibility determination for hunting on Blackwater NWR was approved on August 26, 1994.

Waterfowl hunting in Dorchester County had been a major recreational activity, but when hunters discovered the abundance of deer, and especially the exotic sika deer that could not be found elsewhere, they swarmed to Dorchester County. Interest in hunting on Blackwater NWR increased. When the farming community complained

that the ever increasing population of deer on the refuge seriously depredated their crops, interest in promoting hunting on the refuge increased even more. To assist with the crop situation and provide recreation, the refuge deer hunting program began in 1985. Although the current program allows most of the hunters that apply to participate, during the CCP scoping meetings, hunters requested increased opportunities to hunt deer. They also requested a turkey hunt and a resident goose hunt. The resident Canada geese have become major competitors with native wildlife, and the public recommended hunting as a means of controlling the growing population.

Strategies for Blackwater NWR

The number of hunting days and types of hunts at Blackwater NWR will be increased, as will the acreage available for big game hunting (approximately 10,430 acres, and increasing with protection). Big game hunting for white-tailed and sika deer will be permitted for a minimum of 53 days (45 days of archery hunting generally beginning the last Saturday in September, continuing consecutively until mid-November, and ending with a late archery season beginning the first Saturday in January and ending the third Saturday in January; 2 days of muzzle-loading rifle or shotgun hunting the third Friday and Saturday in October; 2 days of youth only shotgun hunting the second and fourth Saturdays in November; and 4 days of shotgun hunting the first and second Mondays and Fridays of the statewide firearms season), all within State seasons, and consistent with State weapons, bag limits, and hunting hours.

During the archery seasons, all vehicle access will be prohibited, and hunters will walk in from existing designated parking areas. During the firearms seasons, vehicles will be restricted to designated refuge roadways. There will be no off-road vehicle or ATV use allowed during any hunting season. There will be no access allowed by boats during any of the big game hunting seasons. The first section of the Wildlife Drive will only be closed the first 2 days of the shotgun hunt, leaving the second part of the Wildlife Drive open for public use. Hunting opportunities will be provided to a minimum of 3,000 hunters annually on a first come, first served, mail in system (non-quota for the archery season, but with quotas for the firearms hunts). Hunters will be restricted to zoned areas for safe distribution, with a ratio of no more than one hunter per 20 acres, although some areas may have only one hunter per 40 acres.

Blackwater NWR will honor the commitments related to Blackwater NWR protections where the Service assured the public that the historical tradition of hunting deer will be permitted if compatible with the objectives of Blackwater NWR. With the protection of additional property, the refuge will open other areas suitable to hunting with the number of hunters per acre the same, and will increase the number of total hunters accordingly. Check stations will be operated by staff and volunteers during muzzle-loader and shotgun hunts to obtain age, sex, species, and weight data. Deer killed during the archery season will be required to be checked at a Maryland DNR certified checking station. An annual hunt program will be prepared and submitted for review prior to July 1. Summaries of the biological information will be published in the Annual Narrative Report. Administrative fees will be charged for the permits. Senior citizens and youth will receive a 50-percent discount on these fees. Fees will be utilized to hire a hunt program coordinator and maintain parking areas and signs.

One area of the refuge will be designated for certified wheelchair-bound big game hunters. Hunt leaflets, regulations, and maps will be prepared and published annually, and distributed to hunters. Refuge-specific regulations will be published annually in the Federal Register and codified in Title 50, Part 32. A hunter database will be maintained to facilitate mailings and distribution of information. Blackwater NWR will continue taking precautions to safeguard threatened or endangered species and migratory waterfowl. Hunting will be regulated in time and space to eliminate conflicts with endangered species and other public uses and to ensure compatibility with refuge purposes. Annual spotlight surveys, harvest data, herd health conditions, and available habitat will continue to ensure that the deer hunt remained biologically sound.

Deer hunting will continue to provide opportunities to use a renewable resource, while maintaining herd numbers within acceptable levels. Hunting seasons will be adjusted annually to take into consideration changes indicated in herd quality by biological monitoring (APCs, antler size, reproductive rates, etc.).

By April 2007, Blackwater NWR will be open to spring turkey hunting in accordance with State season regulations. Spring turkey hunting on a quota basis will be open Tuesdays and Saturdays for 4 weeks (8 days) during the State season (April 18 to May 16). Turkey hunting will require a permit determined by a lottery system issued to

14 hunters per day (112 hunters) on approximately 7,485 acres in 10 areas (Areas B1, D, M2, N, R, S, T, U1, U2, and U3) located where public use will not occur as specified in the Annual Hunt Plan. Scout days will be authorized the day before each hunt day. New areas will be evaluated and considered as they are protected that will not conflict with public use areas or endangered and threatened species (bald eagle) and will not have a negative impact on other wildlife and habitat resources or public safety. A compatibility determination will be completed for the Blackwater NWR turkey hunt before it will be initiated.

By December 2008, Blackwater NWR will be open to spring hunting (March 15 through April 15) of resident Canada geese according to the Annual Hunt Plan based on the Integrated Wildlife Damage Management Plan for Control of Resident Canada Geese, if consistent with the Service EIS on managing these injurious resident waterfowl. Hunting will occur in areas that will not conflict with public use or endangered and threatened species (bald eagle) and will not have a negative impact on other wildlife and habitat resources or public safety. Boating access to the hunt areas will be closed to non-hunters during the hunting season. Resident goose hunting will require a permit determined by a lottery system issued for 30 blind sites constructed by the hunter within 100 yards of a numbered post. The blind sites will be located in areas B1, B2, G, F, J, K, L, and O on approximately 8,300 acres of marsh (3,731 acres), fields (70 acres), and open water (4,500 acres). Thirty permits per day for 27 days will be issued, providing 810 recreational waterfowl hunting opportunities. New areas will be evaluated and considered as they are protected that will not conflict with public use areas or endangered and threatened species (bald eagle), will not have a negative impact on other wildlife and habitat resources, or adversely affect public safety. Retrievers will be permitted.

Waterfowl hunting, in accordance with state seasons, species, bag limits, and hunting methods, will be permitted on 40 percent of all newly protected land. We will continue to maintain approximately 23,000 acres as an inviolate sanctuary for wintering and migrating waterfowl.

The number of employees who also have law enforcement authority has decreased from six to one since 1989. Having only one collateral duty law enforcement officer could make it difficult to conduct the increased programs and activities. Therefore, new Law Enforcement Officers will be hired to enforce hunting regulations in addition to their other duties.

A Hunt Coordinator will be hired using revenues from user fees to prepare updated mailing lists, regulations, maps, and applications, mail out information, process applications, collect and record money, maintain the hunt areas, conduct the hunts, and collect and record hunt statistics. With the increased deer hunts, a spring turkey hunt, a spring resident Canada goose hunt, a new waterfowl hunting program and an expansion of hunting in newly protected property, a full-time Park Ranger will be required to fulfill all the duties necessary for the Hunt Program.

Strategies for the Chesapeake Island Refuges

On the more than 5,000 acres available on the Island Refuges, waterfowl and rail hunting will be proposed, where compatible, in areas not affected by Secretarial Closing Order. Quotas in accordance with state seasons and bag limits will be permitted on Spring Island, Watts Island, and on South Marsh Island, should Maryland DNR enter into an MOU with the Service for its management or decide to sell the island to the Service. There will be no hunting on Martin NWR, as stated in the Secretarial Closing Order. There will be no hunting on Bloodsworth Island for human safety.

N. Fishing and Boating Management

Background

Fishing and crabbing have been sources of food and recreation in this area since Native Americans were its only inhabitants. When Blackwater NWR was established, it was considered an inviolate sanctuary for wildlife. The refuge owned and regulated all the waters within its original protection boundary. For the sake of protecting migratory bird resources, all of its interior waterways were closed from October 1 to March 31 to prevent disturbances during the peak waterfowl migration and wintering seasons. The waters on the refuge are unmarked, shallow, and often revert to tidal mud flats at low tide, making fishing very difficult. Because of the shallow waterways, increasing salinities, and excessive turbidity resulting from marsh loss, fish populations are very low,

and the sizes of most fish very small. Thus, with the many other opportunities available for fishing in Dorchester County, fishing and crabbing historically have not been recreational opportunities for refuge visitors, except at the Blackwater River and Little Blackwater River bridges, in areas not regulated by the refuge.

The navigable waters of the Nanticoke River will not be subject to refuge regulations, should a national wildlife refuge be established there. Fishing and its associated boating activities will fall under the sole jurisdiction of the State of Maryland. Similarly, the State has jurisdiction in regulating those activities on the Island Refuges, since the Service owns only to mean high water. The Service could only regulate access from the refuge to the river or to the waters of the Chesapeake Bay. However, despite limited opportunities, limited fish populations, and problems with access, the public requested more boat ramps and fishing opportunities during our scoping process.

Strategies for Blackwater NWR

To increase fishing opportunities, we will construct a canoe ramp on Route 335 with a parking area, an accessible boardwalk, a pier along Key Wallace Drive on the Little Blackwater River, and improved mapping and marking of the Blackwater River channel. The historical, seasonally closed area (October 1 through March 31) will be expanded from 5,788 acres to 6,223 acres, in accordance with new Maryland legislation. Signs and printed materials explaining Blackwater NWR rules and regulations will be made available to visitors. Canoeing and boating activities will be monitored and, if necessary, restricted to reduce disturbance of wildlife and impacts on habitat.

Additional staff will provide fishing, crabbing, and boat safety interpretation programs; National Fishing and Boating Week activities; preparation of canoe trails, maps, kiosk information, and signs; posting of navigation signs and boundary signs; and law enforcement of fishing, boating, and crabbing regulations within Blackwater NWR.

Strategies for the Nanticoke protection area

Fishing access will be by boat only. There are adequate public boat ramps at many locations along the Nanticoke River within the protection area. According to the Nanticoke River Watershed Boating Assessment Study in August 1997 (Nanticoke Boating Study), fishing and cruising (sightseeing) dominate the boating activities on the Nanticoke River. The Nanticoke protection area will have no jurisdiction over the waters of the Nanticoke River. The refuge is not authorized to regulate fishing or other waterborne activities within the navigable waters of the State or within areas where water bottoms are State-owned.

Strategies for the Chesapeake Island Refuges

Fishing access will continue to be by boat only from the various public ramps available along the mainland. The refuge maintains jurisdiction only on lands above mean high water level. Tour boats, cruising, commercial and recreational fishing dominate the island boating activities. The Island Refuges are not authorized to regulate fishing or other waterborne activities within the navigable waters of the State or within areas where water bottoms are State-owned.

O. Environmental Education and Interpretation and Wildlife Observation and Photography Management

Background

In the 1930s, when Blackwater NWR was first established as a refuge for migratory birds, it was considered a sanctuary for wildlife. Few visitors came. By the 1960s, people began to take an interest in the refuge for recreation. Schools began to bring students to see wildlife; visitors interrupted working employees to ask questions; and people wanted a place to picnic in a natural setting. In 1963, a recreational area was constructed, consisting of a shelter, rest room, picnic area with tables, charcoal cookers, walkways, and parking area. The area was highly appreciated and sought after by local residents, as it was the only such facility in Dorchester County. It remains one of the few public picnic areas available in the county. Photographers, bird watchers, and picnickers continued to increase, with the pressure of their use being felt by the refuge staff.

A Visitor Center was constructed in 1967. Locally, the new Center was called the Community Center, where the people of the surrounding area could go to ask questions and learn about their renewable resource, wildlife. With the continued demand for wildlife-oriented recreation, an observation tower, Wildlife Drive, and two walking trails were constructed for public use in the late 1960s and early 1970s.. A self-service entrance fee program, begun in 1987, caused an initial drop in visitation but was gradually accepted, continuing the increase in visitation. Four kiosks with interpretive panels were completed in 1999.

Public demand for information prompted the refuge to produce a general leaflet; a birding check list; leaflets on mammals, reptiles and amphibians, and Canada geese; a Wildlife Drive guide; and a Marsh Edge Trail guide. Blackwater NWR became a showcase for wildlife. It also became a place for children to learn firsthand nature's lessons of adaptation and diversity, for adults to see birds and wildlife in their natural environment, and a place to pass on to a new generation a love for America's wildlife. Visitation peaked in 1999, with almost 500,000 visitors using refuge facilities.

In the 1960s, the entire staff participated in refuge environmental interpretation programs. Although well trained and equipped to manage habitat and wildlife, the staff faced new challenges in managing an eager and active public. The idea took hold that a better informed public could be a positive force in shaping conservation awareness, and thus policy and practice. A Public Use Specialist was hired in 1968, increasing the number of environmental and interpretation programs. Visitation continued to increase and required a permanent full-time Outdoor Recreation Planner (ORP), a permanent full-time Recreation Assistant, and as many as two temporary and two seasonal Recreation Assistants.

Since1990, when both the ORP and Recreation Assistant took other positions, Blackwater NWR has had only one ORP and numerous temporary Recreation Assistants, volunteer interns, or Student Conservation Association Volunteers, usually only one at a time for 3-month periods, requiring a great deal of time for recruiting and training. There were also periods as long as 6 months when the ORP tried to cope with the increasing demand with only the assistance of volunteers. It is no longer possible for the refuge to keep up with the expectations and requests of the public without additional staff.

Although a few citizens began to volunteer in 1981, volunteer workshops were not started until 1985. The program reached 104 volunteers in 1994, and has remained consistent, with approximately 100 volunteers providing more than 11,500 hours per year. The Visitor Center is staffed mainly by volunteers, who are at times the only ones on the refuge because of the staff shortage. The Friends of Blackwater (FOB), a cooperative association that established a book store in the Visitor Center in 1988, has since grown to more than 700 members. Sales grossed more than $61,000 in 1999. FOB has procured several grants to assist in refuge projects, and has become nationally known for their mentoring and assistance in developing other "friends" groups. FOB involvement has helped offset staff shortages and inadequate funding.

During our scoping meetings, the public requested more facilities and increased opportunities for public use. In particular, they want increased opportunities for wildlife-oriented education and interpretation, better auto tour routes, more hiking trails, canoe trials and maps, boat ramps, bike trails, an observation tower, increased hunting and fishing, and a remodeled or new Visitor Center. Although the Visitor Center exhibits were upgraded in 1982, they need to be updated to better inform the public of Service and refuge policies, wildlife needs, and the benefits of wildlife conservation.

In response to those concerns, this plan will increase environmental education programs (including the publication of an environmental education manual), increase the number and types of interpretation and outreach programs, photographing facilities, and wildlife observation facilities; construct an environmental education facility; update exhibits and remodel and enlarge the existing Visitor Center; and hire more staff to plan, manage, and conduct the public use program.

Strategies for Blackwater NWR

This plan will increase opportunities for environmental education and interpretation, outreach, and wildlife observation and photography. In addition to the supervisory ORP for the Public Use Program, three permanent full-time ORPs and a permanent full-time Park Ranger (vacancy since 1989) will be hired to help conduct the

Entrance Fee Program, the Volunteer Program, the Interpretation Program, and the Environmental Education Program. Temporary and seasonal employees may become necessary as the environmental education and interpretation programs develop. Three full-time law enforcement personnel also will be hired for the Complex: two at Blackwater and one for the Island Refuges, to do compliance checks, keep visitors informed, and enforce refuge regulations. Not only will that prevent the public from causing a negative impact on the wildlife and habitat by making them aware of refuge regulations and closed areas, it will also increase refuge entrance fees and provide more accurate information on visitation by requiring all visitors to fill out entrance fee envelopes.

Two hundred volunteers will be recruited and trained for the Public Use Program for interpretation, environmental education, outreach, and staffing the Visitor Center, Nanticoke Contact Station, and Environmental Outdoor Classrooms. Environmental education and interpretation are critical tools for the protection of our Nation's wildlife and habitat resources. By placing additional emphasis on environmental education and interpretation at Blackwater NWR, we anticipate that the number of students reached through on-Refuge visits will increase from 2,000 to 20,000 annually. These students will also receive a richer environmental education experience because of the expanded curriculum and additional contact with Blackwater NWR staff.

The increased public use staff will plan, organize and conduct environmental education programs; recruit and train at least 30 volunteers and interns to assist in the environmental education program; manage the environmental education outdoor classrooms; organize two teacher workshops each year; develop environmental education programs that can meet requirements of school curriculums, boy scout, girl scout, 4–H clubs, home school groups, college programs, programs for adults, and special event programs to be available when needed by 2012; develop refuge activities for elementary age visiting groups by January 2009, for middle school groups by October 2010, and high school groups by October 2012; develop an MOU with Henson Scout camp and the 4–H Camp Thendera to work together on environmental education and interpretive programs by 2011; develop an Envirothon for middle and elementary schools by 2017; develop three changeable environmental education activities for the refuge web page by January 2010, alternating programs every 6 months; and, implement an environmental education manual (printing section1 by October 2009, section 2 by October 2010, and section 3 by October 2012).

The manual will be distributed to schools, and feedback gathered one year after each section is published. The environmental education manual will provide teachers with the information to conduct programs meeting their curriculum requirements, beginning with reading, math, social studies, and science activities in their classrooms, bringing students to participate in a hands-on activity on Blackwater NWR, and returning to their classroom to complete the project, meeting the Maryland State School Performance (MSSP) curriculum standards. Steps will be taken to restore the cemetery before it will be used as a learning tool.

Programs will be conducted in small groups, limited to non-sensitive areas having pavement or decking, limited by how often the programs are conducted, and monitored for signs that carrying capacity is being exceeded. Many environmental education and interpretation activities will occur at the newly constructed Environmental Education Outdoor Classrooms, the remodeled Visitor Center, or inside vehicles where there will be little or no physical impact on the environment.

Five shared educational programs and activities with other environmental education centers (Horn Point Environmental Education Center, Karen Noonan Environmental Education Center, Pickering Creek Environmental Education Center, Chesapeake College, Salisbury University, and University of Maryland Eastern Shore) will be developed by October 2014; fostering opportunities for participation of students, co-ops, SCEPS, interns, and SCAs; participation in community and other government agency events with children's environmental education activities; and the development of communication, workshops, and meetings with other environmental education interests (educational community, non-government organizations, and other agencies) to share information, ideas, and assistance with environmental education activities.

The Robbins property, approximately 19 acres located east of Key Wallace Drive near the Visitor Center, where a house recently burned to the ground, will be protected as a site for an Environmental Education Outdoor Classroom. Another Environmental Education Outdoor Classroom will be constructed near the Visitor Contact Station on the Nanticoke protection area by 2017. Equipment and materials will be purchased for environmental education activities. The Environmental Education Outdoor Classrooms will be designed and located in areas that will minimize physical and biological impacts on the environment. The Service will carry out the section 106 process

under the National Historic Preservation Act to ensure that cultural resources were considered in project planning and avoided or treated appropriately before construction is approved. Blackwater NWR will train professionals by providing the opportunity for Outdoor Recreation Planners and selected volunteers to attend appropriate environmental education training.

The staff will manage the interpretation programs, update kiosk information, order and install signs, and design, update, and order refuge leaflets. Projects will include updating present kiosk information panels and providing a kiosk at the entrance to the new Wildlife Drive location, and at the Nanticoke Visitor Contact Station by 2014; developing and constructing trail heads with kiosks at new hiking, canoeing, and biking trails by October 2014; installing interpretive signs in new hiking, biking, and canoeing areas and other areas as needed; producing new Refuge film by 2012, and a Nanticoke protection area film by 2014; purchasing new videos that are applicable to the refuge for use in the Visitor Center as they are produced; revising Mammals and Wildlife Drive Guide leaflets to FWS standard format; and producing a self-guided Woods Trail leaflet, volunteer leaflet, and exotic species leaflet by October 2012; endangered species leaflet and entrance fee leaflet by October 2014; self-guided trail leaflets as trails are developed, and other leaflets as needed.

Most of the interpretation programs will be held inside or outside of the Visitor Center, Environmental Education Center, in vehicles that serve as photo blinds for wildlife, or in designated areas of public use where wildlife can anticipate human visitors and be less likely to have a defensive response. Environmental education and interpretation programs should help lessen impacts by informing visitors about the needs of wildlife and wildlife habitat. This extensive education of the public on natural processes and cultural resources will result in satisfying the curiosity of the public who will otherwise unwittingly cause much damage by their explorations. A sign in the Woods Trail kiosk will explain the history of the steam engine. All items used in displays or held in storage will be properly accounted for and cataloged. Historical items will be placed in a fire-safe storage area. Increased staff and trained Visitor Center volunteers will dispense information concerning cultural and historical resources as appropriate. Interpretive canoe trips on the Blackwater and Nanticoke rivers in the late spring will generate public support and increase public awareness of Blackwater NWR programs and mission.

An upgraded and remodeled Visitor Center with new exhibits will provide increased benefits to the environmental education and interpretation aspects of the program with more space for exhibits, programs, and an accessible second level observation platform. The Visitor Center will be remodeled and expanded by 2008 to include a multipurpose room for 150 people; second floor observation area with scopes; environmental education area; new office space for three ORPs and one Park Ranger, interns, and the volunteer program; sales outlet space for FOB; and a larger exhibit area.

New updated Visitor Center exhibits will be developed. A live action monitor of an eagle nest will be installed in the Visitor Center with educational exhibit on eagles by January 2009; an indoor interactive computer console installed by October 2008; an outdoor interactive computer console installed by 2014; a butterfly garden constructed by October 2008; a habitat demonstration area established by October 2009; and two travelers information stations installed on Route 50: one near Cambridge by January 2008, and one near the Nanticoke River in Vienna by 2012.

A Visitor Contact Station and Office will be constructed along Route 50, where more than 6 million people a year will have the opportunity to stop and visit the refuge and learn more about the Nanticoke River, the Refuge Complex, the Service, and the Eastern Shore. The contact station will be sited where the fewest physical impacts will occur, on a site yet to be determined. The facility will include administrative offices, a visitor contact station with interpretation exhibits, and a maintenance shop capable of housing refuge maintenance vehicles and boats.

Blackwater NWR will participate in local events, such as the Bay Country Festival, 4–H Fairs, Waterfowl Festival, Shad Festival, and other events as they develop; work with Dorchester County Tourism, South Dorchester Folk Museum, Harriet Tubman Organization, and community organizations in events and activities as they are developed; develop ecotourism programs with the new Cambridge conference center at the Hyatt by October 2012; develop better personal relationship with the media; develop a refuge monthly or weekly activity report for the local newspapers and radio stations; involve more people from the community in the Volunteer Program; and participate in the development of watershed-wide cooperative outreach groups of Caroline, Dorchester, Somerset, and Wicomico Counties; and continue to participate in the Nanticoke Watershed Alliance and Lower Shore Tributary Strategies Team.

Increasing Blackwater NWR participation in off-site events and activities will increase public understanding of the importance of wildlife habitats essential to wildlife's survival. When they understand the connection between wildlife's survival and man's survival, they will help protect the habitat and produce minimal impact on the physical habitat of Blackwater NWR and elsewhere. The refuge will continue to work with FOB to seek funding, develop programs, produce projects, expand the cooperative sales outlet, plan and conduct public events, and promote national projects and other activities as they develop.

A Friends group will be established specifically to support outreach and advocacy for the Nanticoke protections and the Nanticoke River watershed. The Friends group will be members of the Nanticoke Watershed Alliance. The group will also support the development of an outreach plan, a volunteer program, interpretation programs, signage, kiosks, a general leaflet and other self-guided leaflets and brochures, the Nanticoke protection area film, and the purchase of other videos applicable to the Nanticoke protection area, the refuge website, interpretive canoe trail, and special events.

By October 2009, the Wildlife Drive will be restructured to enter from the Visitor Center area and exit at the present entrance giving visitors a better view of wildlife along the drive. That change will enable visitors to first get information and assistance from staff and volunteers at the Visitor Center before entering the Wildlife Drive. The second part of the Wildlife Drive will be converted to a bike trail to connect with a bike trail to be constructed by the Maryland Highway Department and Dorchester County along Route 335 to Hip Roof Road, providing a 4- to 5-mile bike trail. That trail will allow a separate area for wildlife observation for hikers and bikers that will not conflict with motorists. Physically separating motorized and non-motorized traffic on the Wildlife Drive will not only improve the safety of the visitor, but also limit the impact on wildlife to only one section of the drive (motorized vehicles will serve as a blind for visitors). Parking areas for visitors wishing to bike will be constructed.

By October 2017, a trail at the Nanticoke River, a demonstration forest trail, and an observation walking trail on the Newcomb tract will be constructed with associated parking areas for visitors. The wildlife observation trails will be constructed mostly in existing roadway, in a areas presently closed to visitors that will have minor physical impact on the surrounding forested habitat. Benches will be installed along the existing and new observation trails to allow visitors to rest and enjoy observing wildlife.

By January 2012, the observation tower that was removed in 1990 because of structural deficiencies and other safety hazards will be replaced with an accessible deck and elevated observation platform over wetlands to the water's edge at the junction of Little Blackwater River and Blackwater River, to be used for environmental education programs as well as for visitors to view the wetlands. An observation tower, canoe access ramp and controlled parking area, and an accessible boardwalk and pier on or adjacent to the Nanticoke River will be constructed.

By January 2010, three observation and photography blinds will be installed. They will be designed and constructed with natural visual and noise screen and buffer zones to minimize impacts on Blackwater NWR resources or wildlife. The first will be along the Wildlife Drive with a deck over the marsh and enclosed photo blind. The second will be near the entrance to the second half of the Wildlife Drive, and the third along the 4-mile Gum Swamp observation trail. Photography programs will be provided for the public for each of the four seasons of the year. The construction of all new observation and photographic facilities will be located and designed to minimize impact on wildlife and habitat. Before increasing wildlife observation and photographic opportunities, a thorough examination of the new activity or facility addition will occur to insure that the change will not negatively impact the resource.

By January 2012, six observation and photography blinds will be installed. They will be designed and constructed with natural visual and noise screen and buffer zones to minimize impacts on Blackwater NWR resources or wildlife. The first will be along the Wildlife Drive with a deck over the marsh and enclosed photo blind. The others will be near the entrance to the second half of the Wildlife Drive, along the 4-mile Gum Swamp observation trail, the demonstration forest trail, and near the Nanticoke River. Photography programs will be provided for the public for each of the four seasons of the year. The construction of all new observation and photographic facilities will be located and designed to minimize impact on wildlife and habitat. Prior to increasing wildlife observation and photographic opportunities, a thorough examination of the new activity or facility addition will occur to insure that the change will not negatively impact the resource.

Strategies for the Chesapeake Island Refuges

This plan will increase environmental education and interpretation activities. The visitor contact station at the Middleton House on Smith Island will be upgraded to provide new displays and updated material on the Island Refuges; provide office space with telephone, fax machine, computer, and copy machine; suitable furniture for second floor lodging of interns and researchers; and upgraded plumbing and electrical systems. In the town of Ewell, lands will be purchased to construct an Environmental Educational Center highlighting Island Refuge ecology in partnership with the Chesapeake Bay Foundation. Protection will focus on suitable properties nearby to the Middleton House.

A kiosk will be constructed at the Ewell ferry dock to provide information and direction to the Middleton House and the environmental education and interpretation center. Exhibits and habitat restoration projects will be developed for the environmental education center. A professional video on the Island Refuge, other applicable videos, a video projector, and screen will be purchased to show films on Island Refuges, wildlife, and wildlife habitat to the public. A general leaflet and other self-guided leaflets and brochures, and additional outdoor displays will be developed. An outdoor spotting scope will be installed. Signs will be installed where needed.

In association with the new Environmental Education Center, a wildlife observation trail or boardwalk will be constructed on Martin NWR. Resources profiled will include waterfowl, waterbirds, and saltmarsh ecology. In addition, an observation tower and viewing and photography blinds will be constructed in suitable locations. A needs assessment will be conducted in cooperation with partners to determine the scope, extent, and compatibility of proposed and additional facilities and programs.

An Outdoor Recreation Planner will be hired to provide the increased public use program activities, supervise interns, and conduct education, interpretation, and outreach programs for the Island Refuges. One law enforcement officer will be hired to be a preventive presence on the islands and assist with outreach programs and daily maintenance of equipment and facilities. A volunteer program will be developed for monitoring, interpretation, education programs and outreach, and maintenance of the Island Refuges.

Partnerships with The Chesapeake Bay Foundation, U.S. Army Corps of Engineers, National Fish and Wildlife Foundation, National Aquarium in Baltimore, National Oceanic and Atmospheric Association, and the local Waterman Museum will be established to provide additional programing and educational opportunities for visitors. An MOU with The Chesapeake Bay Foundation will be maintained to work together on environmental education and interpretation programs and events. Outreach programs will be expanded to reach an additional 15,000 visitors by incorporating summer programs that coincide with tour boats visiting the Island Refuges. A Friends group to create a small cooperative sales outlet, to provide Federal passes, educational books, and other educational items; seek funding; develop programs; and produce projects will be established. Upon completion of a compatibility determination, an interpretive canoe or kayak trail will be developed between Island Refuges. Guided estuarine interpretation tours will be provided for educational groups during the spring and fall months.

Chapter 5. Administration

USFWS

Osprey

Introduction

Management and administrative staff for the Complex will be headquartered in the Complex's new office facility that was completed in 2001 and is located on Blackwater NWR, 10 miles south of Cambridge, Maryland. In addition to administering Blackwater, Martin, and Susquehanna NWRs, and their respective divisions, future consideration will be given to adding administrative responsibilities for Eastern Neck NWR.

Refuge Staffing

Current and future staff positions are identified in the Staffing Chart (Appendix D). Additional positions identified will be subject to availability of funding and appropriations. However, the base number of full-time equivalent positions for the current Complex has been determined to be 19 staff: three managerial positions; four biologists; a forester; three visitor services specialists; a law enforcement officer; two administrative personnel; and five maintenance professionals. Three of these positions (forester, visitor services specialist, and heavy equipment mechanic) are currently vacant and will be hired by the end of FY 2007. Seven additional positions (four associated with the Nanticoke division) will be required to fully accomplish the plan's goals and objectives, and these positions will be hired as funds become available. Seasonal positions and interns will be hired for specific projects, also as funding becomes available. Interns will typically work 8-12 weeks each summer, and be offered free housing in the bunkhouse or other temporary quarters.

In addition to the operational staff positions identified above, the fire management program will be supported by the following full-time positions: Fire Management Officer, dispatcher, fire control officer, wildfire specialist, a lead forestry technician; and a forestry technician/firefighter. Four seasonal forestry technicians/firefighters will be hired annually. All of these positions are currently funded, and no additional positions are needed to achieve CCP objectives.

Refuge Funding

Successful implementation of the CCP relies on our ability to secure funding, personnel, infrastructure, and other resources to accomplish the actions identified. The existing annual operating budget for the Complex is approximately $2.1 million, plus an additional $500,000 for the annual fire management program. Full implementation of the actions and strategies in this CCP would incur one-time costs of an additional $9.2 million and annual recurring costs of an additional $2.4 million. The existing Refuge Operating and Needs (RONS) database presents a list of specific projects, and identifies associated one-time costs and recurring costs to fully implement this plan. Refuge staff can provide information about projects in the database. Grants and donations are also important funding components for the Complex, generating hundreds of thousands of dollars annually. These funds, often acquired through the cooperative agreement with the Friends of Blackwater, a non-profit refuge support group, are essential for operating many programs. Partnerships with local, regional, national, and international stakeholders and other interested parties are likewise very important, and will be pursued.

Step-down Management Plans

The Refuge Manual (Part 4, Chapter 3) lists a number of stepdown management plans generally required on most refuges. These plans describe specific management actions refuges will follow to achieve objectives or implement management strategies. Some require annual revisions, such as hunt plans, while others are revised on a 5-to-10 year schedule. Some of these plans require NEPA analysis before they can be implemented. A list of Step-Down Management Plans can be obtained from the refuge.

Maintaining Existing Facilities

Periodic maintenance of existing facilities is critical to ensure safetyand accessibility for refuge staff and visitors. Existing facilities include the refuge headquarters, maintenance compound, Bunkhouse, numerous parking areas and gates, numerous kiosks, trails, and roads. Some of these facilities are not currently Americans with Disabilities Act (ADA) compliant; upgrading is needed. The System Asset Maintenance Management System (SAMMS) is database list of maintenance needs for the refuge. Please contact the refuge for information about the current list.

Compatibility Determinations

Federal law and policy provide the direction and planning framework to protect the Refuge System from incompatible or harmful human activities and to ensure that Americans can enjoy Refuge System lands and waters. The Administration Act, as amended by the Refuge Improvement Act, is the key legislation on managing public uses and compatibility. Before activities or uses are allowed on a national wildlife refuge, we must determine that each is a "compatible use." A compatible use is a use that, based on the sound professional judgment of the Refuge Manager, "...will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge." "Wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety (Refuge Improvement Act). Compatibility Determinations (CDs) were distributed (in the draft CCP/EA) for a 40 day public review in May – July 2005. These CDs have since been approved, and will allow the continuation of the following public use programs: wildlife observation, wildlife photography, environmental education, interpretation, fishing, and hunting. All comments were considered and utilized in the revision. These new CDs are now final and included in Appendix E.

Additional CDs will be developed when appropriate new uses are proposed. CDs will be re-evaluated by the Refuge Manager when conditions under which the use is permitted change significantly; when there is significant new information on effects of the use; or at least every 10 years for non-priority public uses. Priority public use CDs will be re-evaluated under the conditions noted above, or at least every 15 years with revision of the CCP. Additional detail on the CD process is in Parts 25, 26, and 29 of Title 50 of the Code of Federal Regulations, effective November 17, 2000.

Appropriate Uses

To allow the use of a national wildlife refuge, the refuge manager must find that the use is both appropriate and compatible. A policy for dealing with determinations of appropriateness was released to the public on July 20, 2006 and became final in July of 2006. The policy requires that each refuge develop determinations of appropriateness for all activities that occur on the refuge within one year of the final policy, unless they are adequately described in a refuge CCP. This CCP addresses all of the allowed uses for the Complex. Any future compatibility determinations will include findings of appropriateness.

The appropriate uses policy states that refuges are first and foremost national treasures for the conservation of wildlife. Through careful planning, consistent Refuge Systemwide application of regulations and policies, diligent monitoring of the impacts of uses on wildlife resources, and preventing or eliminating uses not appropriate to the Refuge System, we can achieve the Refuge System conservation mission while also providing the public with lasting opportunities to enjoy quality, compatible, wildlife-dependent recreation.

The "Appropriate Uses" policy provides refuge managers consistent guidelines to administer and structure recreational activities. The policy provides a framework to determine if activities that are not wildlife-dependent may be appropriate for a particular refuge.

Wilderness

As required by Service policy, the refuge staff evaluated the lands of each national wildlife refuge included in this CCP for consideration of Wilderness designation. The Wilderness Act of 1964 established the National Wilderness Preservation System and requires that federal lands be reviewed for appropriateness for inclusion in that System. Appendix F provides the Wilderness Review that was conducted.

Monitoring and Evaluation

This Final CCP covers a 15-year period. Periodic review of the CCP is required to ensure that established goals and objectives are being met, and that the plan is being implemented as scheduled. To assist this review process, a monitoring and evaluation program will be implemented, focusing on issues involving public use activities, and wildlife habitat and population management.

Monitoring of public use programs will involve the continued collection and compilation of visitation fi gures and activity levels. In addition, research and monitoring programs will be established to assess the impacts of public use activities on wildlife and wildlife habitat, assess conflicts between types of refuge uses, and to identify compatible levels of public use activities. We will reduce these public use activities if we determine that incompatible levels are occurring. We will monitor refuge habitat management programs for positive and negative impacts on wildlife habitat and populations and the ecological integrity of the ecosystem. The monitoring will be of assistance in determining if these management activities are helping to meet refuge goals. Information resulting from monitoring would allow staff to set more specific and better management objectives, more rigorously evaluate management objectives, and ultimately, make better management decisions. This process of evaluation, implementation and reevaluation is known simply as “adaptive resource management”.

Monitoring and Evaluation for this CCP will occur at two levels. The first level, which we refer to as implementation monitoring, responds to the question, “Did we do what we said we would do, when we said we would do it?” The second level of monitoring, which we refer to as effectiveness monitoring, responds to the question, “Are the actions we proposed effective in achieving the results we had hoped for?” Or, in other words, “Are the actions leading us toward our vision, goals, and objectives?” Effectiveness monitoring evaluates an individual action, a suite of actions, or an entire resource program. This approach is more analytical in evaluating management effects on species, populations, habitats, refuge visitors, ecosystem integrity, or the socioeconomic environment. More often, the criteria to monitor and evaluate these management effects will be established in step-down, individual project, or cooperator plans, or through the research program. The Habitat and Wildlife Inventory and Monitoring Plan, to be completed, will be based on the needs and priorities identified in the HMP.

Adaptive Management

This CCP is a dynamic document. A strategy of adaptive management will keep it relevant and current. Through scientific research, inventories and monitoring, and our management experiences, we will gain new information which may alter our course of action. We acknowledge that our information on species, habitats, and ecosystems is incomplete, provisional, and subject to change as our knowledge base improves. Objectives and strategies must be adaptable in responding to new information, as well as changes in time and location. We will continually evaluate management actions, through monitoring or research, and to reconsider whether their original assumptions and predictions are still valid. In this way, management becomes an active process of learning “what really works”. It is important that the public understand and appreciate the adaptive nature of natural resource management.

The Refuge Manager is responsible for changing management actions or objectives if they do not produce the desired conditions. Significant changes may warrant additional NEPA analysis; minor changes will not, but will be documented in annual monitoring, project evaluation reports, or the annual refuge narratives.

Additional NEPA Analysis

NEPA requires a site specific analysis of impacts for all federal actions. These impacts are to be disclosed in either an EA or EIS. Most of the actions and associated impacts in this plan were described in enough detail in the draft CCP/EA to comply with NEPA, and will not require additional environmental analysis. Although this is not an all inclusive list, the following programs are examples that fall into this category: protecting and restoring wildlife habitat, implementing priority wildlife dependent public use programs, acquiring land, and controlling invasive plants.

Two actions described in the draft CCP/EA have been addressed under separate EA's. The Atlantic white cedar restoration and the reintroduction of red-cockaded woodpeckers are projects that have moved forward under these project-specifi c EA's. A few actions may not be described in enough detail to comply with the site specifi c analysis requirements of NEPA. Examples of actions that may require a separate EA include: future habitat restoration projects not fully developed or delineated in this document or any identified projects that may changed signifi cantly from what is described in the draft CCP/EA. Monitoring, evaluation, and research can generally be increased without additional NEPA analysis.

Plan Amendment and Revision

Periodic review of the CCP will be required to ensure that objectives are being met and management actions are being implemented. Ongoing monitoring and evaluation will be an important part of this process. Monitoring results or new information may indicate the need to change our strategies.

The Service's planning policy (FWS Manual, Part 602, Chapters 1, 3, and 4) states that CCPs should be reviewed at least annually to decide if they require any revisions (Chapter 3, part 3.4 (8)). Revisions will be necessary if signifi cant new information becomes available, ecological conditions change, major refuge expansions occur, or when we identify the need to do so during a program review. At a minimum, CCPs will be fully revised every 15 years. We will modify the CCP documents and associated management activities as needed, following the procedures outlined in Service policy and NEPA requirements. Minor revisions that meet the criteria for categorical exclusions (550 FW 3.3C) will only require an Environmental Action Statement

Glossary

USFWS

Mallard with brood

Accessibility	the state or quality of being easily approached or entered, particularly as it relates to complying with the Americans With Disabilities Act
accessible facilities	structures accessible for most people with disabilities without assistance; facilities that meet UFAS standards; ADA-accessible [E.g., parking lots, trails, pathways, ramps, picnic and camping areas, restrooms, boating facilities (docks, piers, gangways), fishing facilities, playgrounds, amphitheaters, exhibits, audiovisual programs, and wayside sites.]
aggregate	many parts considered together as a whole
agricultural land	nonforested land (now or recently orchards, pastures, or crops)
alternative	a reasonable way to fix an identified problem or satisfy a stated need [40 CFR 1500.2 (cf. "management alternative")]
amphidromous fish	fish that can migrate from fresh water to the sea or the reverse, not only for breeding, but also regularly at other times during their life cycle
appropriate use	a proposed or existing use on a refuge that meets at least one of the following three conditions: 1. the use is a wildlife-dependent one; 2. the use contributes to fulfilling the refuge purpose(s), the System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the National Wildlife Refuge System Improvement Act was signed into law; or 3. the use has been determined to be appropriate as specified in section 1.11
approved acquisition boundary	a project boundary that the Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands which the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the System until the Service buys them or they are placed under an agreement that provides for their management as part of the System.
anadromous fish	from the Greek, literally "up-running"; fish that spend a large portion of their life cycle in the ocean and return to freshwater to breed
aquatic	growing in, living in, or dependent upon water
aquatic barrier	any obstruction to fish passage
aquifer	a formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs

area of biological significance	cf. "special focus area"
area-sensitive species	species that require large areas of contiguous habitat
assemblage	in conservation biology, a predictable and particular collection of species within a biogeographic unit (e.g., ecoregion or habitat)
barrens	a colloquial name given to habitats with sparse vegetation or low agricultural productivity
barrier	cf. "aquatic barrier"
basin	the land surrounding and draining into a water body (cf. "watershed")
benthic	living at, in, or associated with structures on the bottom of a body of water
best management practices	land management practices that produce desired results [N.b. Usually describing forestry or agricultural practices effective in reducing non-point source pollution, like reseeding skidder trails or not storing manure in a flood plain. In their broader sense, practices that benefit target species.]
biological diversity or biodiversity	the variety of life and its processes and includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur
biological integrity	biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms and communities
bog	a poorly drained area rich in plant residues, usually surrounded by an area of open water, and having characteristic flora
breeding habitat	habitat used by migratory birds or other animals during the breeding season
buffer zones	land bordering and protecting critical habitats or water bodies by reducing runoff and nonpoint source pollution loading; areas created or sustained to lessen the negative effects of land development on animals, plants, and their habitats
candidate species	species for which we have sufficient information on file about their biological vulnerability and threats to propose listing them
catadromous fish	fish that spend most of their lives in fresh water, but migrate to sea to reproduce
categorical exclusion [CE, CX, CATEX, CATX]	pursuant to the National Environmental Policy Act (NEPA) , a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment [40 CFR 1508.4]

CFR	the Code of Federal Regulations
Challenge Cost Share Program	a Service-administered grant program that provides matching funds for projects supporting natural resource education, management, restoration, or protection on Service lands, other public lands, and private lands
citizen monitoring projects	projects coordinated locally to conduct environmental inventories; their data expand what agencies know, and are available to anyone interested
community	the locality in which a group of people resides and shares the same government
community type	a particular assemblage of plants and animals, named for its dominant characteristic
compatible use	"The term 'compatible use' means a wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge."—National Wildlife Refuge System Improvement Act of 1997 [Public Law 105-57; 111 Stat. 1253]
compatibility determination	a required determination for wildlife-dependent recreational uses or any other public uses of a refuge
Comprehensive Conservation Plan	(CCP) mandated by the Improvement Act, a document that provides a description of the desired future conditions and long-range guidance for the project leader to accomplish purposes of the refuge system and the refuge. CCPs establish management direction to achieve refuge purposes. [P.L. 105-57; FWS Manual 602 FW 1.4]
concern	cf. "issue"
conifer	a tree or shrub in the phylum Gymnospermae whose seeds are borne in woody cones. There are 500–600 species of living conifers (Norse 1990)
conservation	managing natural resources to prevent loss or waste [N.b. Management actions may include preservation, restoration, and enhancement.]
conservation agreements	written agreements among two or more parties for the purpose of ensuring the survival and welfare of unlisted species of fish and wildlife or their habitats or to achieve other specified conservation goals. Participants voluntarily commit to specific actions that will remove or reduce threats to those species.
conservation easement	a legal agreement between a landowner and a land trust (e.g., a private, nonprofit conservation organization) or government agency that permanently limits the uses of a property to protect its conservation values

cool-season grass — introduced grass for crop and pastureland that grows in spring and fall and is dormant during hot summer months

cooperative agreement — a usually long-term habitat protection action, which can be modified by either party, in which no property rights are acquired. Lands under a cooperative agreement do not necessarily become part of the National Wildlife Refuge System

critical habitat — according to U.S. Federal law, the ecosystems upon which endangered and threatened species depend

cultural resource inventory — a professional study to locate and evaluate evidence of cultural resources within a defined geographic area
[N.b. Various levels of inventories may include background literature searches, comprehensive field examinations to identify all exposed physical manifestations of cultural resources, or sample inventories for projecting site distribution and density over a larger area. Evaluating identified cultural resources to determine their eligibility for the National Register follows the criteria in 36 CFR 60.4 (cf. FWS Manual 614 FW 1.7).]

cultural resource overview — a comprehensive document prepared for a field office that discusses, among other things, project prehistory and cultural history, the nature and extent of known cultural resources, previous research, manage-ment objectives, resource management conflicts or issues, and a general statement of how program objectives should be met and conflicts resolved
[An overview should reference or incorporate information from a field offices background or literature search described in section VIII of the Cultural Resource Management Handbook (FWS Manual 614 FW 1.7).]

database — a collection of data arranged for ease and speed of analysis and retrieval, usually computerized

dedicated open space — land to be held as open space forever

degradation — the loss of native species and processes due to human activities such that only certain components of the original biodiversity persist, often including significantly altered natural communities

designated wilderness area — an area designated by Congress as part of the National Wilderness Preservation System [FWS Manual 610 FW 1.5 (draft)]

diadromous — fish that migrate from freshwater to saltwater or the reverse; a generic term that includes anadromous, catadromous, and amphidromous fish

digitizing — the process of converting maps into geographically referenced electronic files for a geographic information system (GIS)

disturbance — any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment

donation	a citizen or group may wish to give land or interests in land to the Service for the benefit of wildlife. Aside from the cost factor, these acquisitions are no different than any other means of land acquisition. Gifts and donations have the same planning requirements as purchases.
drumlin	a ridge or oval hill with a smooth summit composed of material deposited by a glacier
easement	an agreement by which landowners give up or sell one of the rights on their property [E.g., landowners may donate rights-of-way across their properties to allow community members access to a river (cf. "conservation easement").]
ecological processes	a complex mix of interactions among animals, plants, and their environment that ensures maintenance of an ecosystem's full range of biodiversity. Examples include population and predator-prey dynamics, pollination and seed dispersal, nutrient cycling, migration, and dispersal
ecoregion	a territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.
ecosystem	a natural community of organisms interacting with its physical environment, regarded as a unit
ecosystem service	a benefit or service provided free by an ecosystem or by the environment, such as clean water, flood mitigation, or groundwater recharge
ecotourism	visits to an area that maintains and preserves natural resources as a basis for promoting its economic growth and development
ecosystem approach	a way of looking at socio-economic and environmental information based on the boundaries of ecosystems like watersheds, rather than on geopolitical boundaries
ecosystem-based management	an approach to making decisions based on the characteristics of the ecosystem in which a person or thing belongs [N.b. This concept considers interactions among the plants, animals, and physical characteristics of the environment in making decisions about land use or living resource issues.]
emergent wetland	wetlands dominated by erect, rooted, herbaceous plants
endangered species	a Federal- or State-listed protected species in danger of extinction throughout all or a significant portion of its range
endemic	a species or race native to a particular place and found only there
environmental education	curriculum-based education aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated

	problems, aware of how to help solve those problems, and motivated to work toward solving them
environmental health	the composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment
Environmental Assessment	(EA) a public document that discusses the purpose and need for an action, its alternatives, and provides sufficient evidence and analysis of its impacts to determine whether to prepare an environmental impact statement or a finding of no significant impact (q.v.) [cf. 40 CFR 1508.9]
Environmental Impact Statement	(EIS) a detailed, written analysis of the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources [cf. 40 CFR 1508.11]
estuaries	deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from land
estuarine wetlands	"The Estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land."—Cowardin et al. 1979
exemplary community type	an outstanding example of a particular community type
Extinction	the termination of any lineage of organisms, from subspecies to species and higher taxonomic categories from genera to phyla. Extinction can be local, in which one or more populations of a species or other unit vanish but others survive elsewhere, or total (global), in which all the populations vanish (Wilson 1992)
extirpated	status of a species or population that has completely vanished from a given area but that continues to exist in some other location
exotic species	a species that is not native to an area and has been introduced intentionally or unintentionally by humans; not all exotics become successfully established
Federal land	public land owned by the Federal Government, including national forests, national parks, and national wildlife refuges
Federal-listed species	a species listed either as endangered, threatened, or a species at risk (formerly, a “candidate species”) under the Endangered Species Act of 1973, as amended

fee-title acquisition — the acquisition of most or all of the rights to a tract of land; a total transfer of property rights with the formal conveyance of a title. While a fee-title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or use reservation (e.g., the ability to continue using the land for a specified time period, such as the remainder of the owner's life).

Finding of No Significant Impact — (FONSI) supported by an environmental assessment, a document that briefly presents why a Federal action will have no significant effect on the human environment, and for which an environmental impact statement, therefore, will not be prepared [40 CFR 1508.13]

fire regime — the characteristic frequency, intensity, and spatial distribution of natural fires within a given ecoregion or habitat

fish passage project — providing a safe passage for fish around a barrier in the upstream or downstream direction

floodplain — flat or nearly flat land that may be submerged by floodwaters; a plain built up or in the process of being built up by stream deposition

focus areas — cf. "special focus areas"

forbs — flowering plants (excluding grasses, sedges, and rushes) that do not have a woody stem and die back to the ground at the end of the growing season

forest association — the community described by a group of dominant plant (tree) species occurring together, such as spruce-fir or northern hardwoods

forested land — land dominated by trees
[For impacts analysis in CCP's, we assume all forested land has the potential for occasional harvesting; we assume forested land owned by timber companies is harvested on a more intensive, regular schedule.]

forested wetlands — wetlands dominated by trees

fragmentation — the disruption of extensive habitats into isolated and small patches. Fragmentation has two negative components for biota: the loss of total habitat area; and, the creation of smaller, more isolated patches of habitat remaining.

GAP analysis — the use of various remote sensing data sets to build overlaid sets of maps of various parameters (e.g., vegetation, soils, protected areas, species distributions) to identify spatial gaps in species protection and management programs

geographic information system — (GIS) a computerized system to compile, store, analyze and display geographically referenced information [E.g., GIS can overlay multiple sets of information on the distribution of a variety of biological and physical features.]

glade — an open space surrounded by forest

grant agreement	the legal instrument used when the principal purpose of the transaction is the transfer of money, property, services, or anything of value to a recipient in order to accomplish a public purpose of support or stimulation authorized by Federal statute and substantial involvement between the Service and the recipient is *not* anticipated (cf. "cooperative agreement")
grassland	a habitat type with landscapes dominated by grasses and with biodiversity characterized by species with wide distributions, communities being relatively resilient to short-term disturbances but not to prolonged, intensive burning or grazing. In such systems, larger vertebrates, birds, and invertebrates display extensive movement to track seasonal or patchy resources
grassroots conservation organization	any group of concerned citizens who act together to address a conservation need
groundwater	water in the ground that is in the zone of saturation, from which wells and springs and groundwater runoff are supplied
guild	a group of organisms, not necessarily taxonomically related, that are ecologically similar in characteristics such as diet, behavior, or microhabitat preference, or with respect to their ecological role in general
habitat block	a landscape-level variable that assesses the number and extent of blocks of contiguous habitat, taking into account size requirements for populations and ecosystems to function naturally. It is measured here by a habitat-dependent and ecoregion size-dependent system
habitat fragmentation	the breaking up of a specific habitat into smaller, unconnected areas [N.b. A habitat area that is too small may not provide enough space to maintain a breeding population of the species in question.]
habitat conservation	protecting an animal or plant habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced
habitat	the place where a particular type of plant or animal lives [N.b. An organism's habitat must provide all of the basic requirements for life, and should be free of harmful contaminants.]
historic conditions	the composition, structure and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgement, were present prior to substantial human-related changes to the landscape
hydrologic or flow regime	characteristic fluctuations in river flows
hydrology	the science of waters of the earth: their occurrences, distributions, and circulations; their physical and chemical properties; and their reactions with the environment, including living beings
important fish areas	the aquatic areas identified by private organizations, local, state, and federal agencies that meet the purposes of the Conte Act

impoundment	a body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, which is used to collect and store water for future use
indicator species	a species used as a gauge for the condition of a particular habitat, community, or ecosystem. A characteristic or surrogate species for a community or ecosystem
indigenous	native to an area
indigenous species	a species that, other than a result as an introduction, historically occurred or currently occurs in a particular ecosystem
informed consent	"the grudging willingness of opponents to go along with a course of action that they actually oppose."—Bleiker
interjurisdictional fish	populations of fish that are managed by two or more States or national or tribal governments because of the scope of their geographic distributions or migrations
interpretive facilities	structures that provide information about an event, place, or thing by a variety of means, including printed, audiovisual, or multimedia materials [E.g., kiosks that offer printed materials and audiovisuals, signs, and trail heads.]
interpretive materials	any tool used to provide or clarify information, explain events or things, or increase awareness and understanding of the events or things [E.g., printed materials like brochures, maps or curriculum materials; audio/visual materials like video and audio tapes, films, or slides; and, interactive multimedia materials, CD-ROM or other computer technology.]
interpretive materials projects	any cooperative venture that combines financial and staff resources to design, develop, and use tools for increasing the awareness and understanding of events or things related to a refuge
introduced invasive species	non-native species that have been introduced into an area and, because of their aggressive growth and lack of natural predators, displace native species
invasive species	an alien species whose introduction causes or is likely to cause economic or environmental harm or harm to human health
invertebrate	any animal lacking a backbone or bony segment that encloses the central nerve cord
issue	any unsettled matter that requires a management decision [E.g., a Service initiative, an opportunity, a management problem, a threat to the resources of the unit, a conflict in uses, a public concern, or the presence of an undesirable resource condition.] [N.b. A CCP should document, describe, and analyze issues even if they cannot be resolved during the planning process (FWS Manual 602 FW 1.4).]

kettle hole	a generally circular hollow or depression in an *outwash plain* or *moraine*, believed to have formed where a large block of subsurface ice has melted
keystone species	species that are critically important for maintaining ecological processes or the diversity of their ecosystems
lacustrine wetlands	"The Lacustrine system includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds eight ha (20 acres)."—Cowardin et al. 1979
Land Protection Plan	(LPP) a document that identifies and prioritizes lands for potential Service acquisition from a willing seller, and also describes other methods of providing protection. Landowners within project boundaries will find this document, which is released with environmental assessments, most useful.
land trusts	organizations dedicated to conserving land by purchase, donation, or conservation easement from landowners
landform	the physical shape of the land reflecting geologic structure and processes of geomorphology that have sculpted the structure
landscape	an aggregate of landforms, together with its biological communities
late-successional	species, assemblages, structures, and processes associated with mature natural communities that have not experienced significant disturbance for a long time
limiting factor	an environmental limitation that prevents further population growth
limits of acceptable change	a planning and management framework for establishing and maintaining acceptable and appropriate environmental and social conditions in recreation settings
local land	public land owned by local governments, including community or county parks or municipal watersheds
local agencies	generally, municipal governments, regional planning commissions, or conservation groups
long-term protection	mechanisms like fee title acquisition, conservation easements, or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintaining species populations over the long term
macroinvertebrates	invertebrates large enough to be seen with the naked eye (e.g., most aquatic insects, snails, and amphipods)
management alternative	a set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4]

management concern	cf. "issue" and "migratory nongame birds of management concern"
management opportunity	cf. "issue"
management plan	a plan that guides future land management practices on a tract [N.b. In the context of an environmental impact statement, management plans may be designed to produce additional wildlife habitat along with primary products like timber or agricultural crops (cf. "cooperative agreement").]
management strategy	a general approach to meeting unit objectives [N.b. A strategy may be broad, or it may be detailed enough to guide implementation through specific actions, tasks, and projects (FWS Manual 602 FW 1.4).]
mesic soil	sandy-to-clay loams containing moisture-retentive organic matter, well drained (no standing matter)
migratory nongame birds of management concern	species of nongame birds that (*a*) are believed to have undergone significant population declines; (*b*) have small or restricted populations; or (*c*) are dependent upon restricted or vulnerable habitats
mission statement	a succinct statement of the purpose for which the unit was established; its reason for being
mitigation	actions to compensate for the negative effects of a particular project [E.g., wetland mitigation usually restores or enhances a previously damaged wetland or creates a new wetland.]
moraine	a mass or ridge of earth scraped up by ice and deposited at the edge or end of a glacier
National Environmental Policy Act of 1969	(NEPA) requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in planning and implementing environmental actions [Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision-making (cf. 40 CFR 1500).]
National Wildlife Refuge Complex	(Complex) an internal Service administrative linking of refuge units closely related by their purposes, goals, ecosystem, or geopolitical boundaries
National Wildlife Refuge System	(System) all lands and waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish and wildlife, including those that are threatened with extinction
native	a species that, other than as a result of an introduction, historically occurred or currently occurs in a particular ecosystem

native plant	a plant that has grown in the region since the last glaciation, and occurred before European settlement
natural disturbance event	any natural event that significantly alters the structure, composition, or dynamics of a natural community: e.g., floods, fires, and storms
natural range of variation	a characteristic range of levels, intensities, and periodicities associated with disturbances, population levels, or frequency in undisturbed habitats or communities
Neotropical migrant	birds, bats, or invertebrates that seasonally migrate between the Nearctic and Neotropics
non-consumptive, wildlife-oriented recreation	wildlife observation and photography and environmental education and interpretation (cf. "wildlife-oriented recreation")
non-native species	See "exotic species."
non-point source pollution	a diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from a number of points that are spread out and difficult to identify and control (Eckhardt 1998)
nonforested wetlands	wetlands dominated by shrubs or emergent vegetation
nonpoint source	a diffuse form of water quality degradation produced by erosion of land that causes sedimentation of streams, eutrophication from nutrients and pesticides used in agricultural and silvicultural practices, and acid rain resulting from burning fuels that contain sulfur (Lotspeich and Platts 1982)
Notice of Intent	(NOI) an announcement we publish in the Federal Register that we will prepare and review an environmental impact statement [40 CFR 1508.22]
objective	cf. "unit objective"
obligate species	a species that must have access to a particular habitat type to persist
occurrence site	a discrete area where a population of a rare species lives or a rare plant community type grows
old fields	areas formerly cultivated or grazed, where woody vegetation has begun to invade [N.b. If left undisturbed, old fields will eventually succeed into forest. Many occur at sites marginally suitable for crops or pasture. They vary markedly in the Northeast, depending on soil and land use and management history.]
outdoor education project	any cooperative venture that combines financial and staff resources to develop outdoor education activities like labs, field trips, surveys, monitoring, or sampling

outdoor education	educational activities that take place in an outdoor setting
outwash plain	the plain formed by deposits from a stream or river originating from the melting of glacial ice that are distributed over a considerable area; generally coarser, heavier material is deposited nearer the ice and finer material carried further away
palustrine wetlands	"The Palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0%."—Cowardin et al. 1979
Partners for Wildlife Program	a voluntary, cooperative habitat restoration program among the Service, other government agencies, public and private organizations, and private landowners to improve and protect fish and wildlife habitat on private land while leaving it in private ownership
partnership	a contract or agreement among two or more individuals, groups of individuals, organizations, or agencies, in which each agrees to furnish a part of the capital or some service in kind (e.g., labor) for a mutually beneficial enterprise
payment in lieu of taxes	cf. Revenue Sharing Act of 1935, Chapter One, Legal Context
pelagic	living in the water column, well above the bottom and some distance from land, as do oceanic fish or birds (contrast *demersal* and *benthic*)
phytoplankton	the ensemble of tiny plants that float or drift in marine waters. These tiny plants can produce such dense blooms in the Gulf of Maine that they turn our waters green. Phytoplankton are the base of the food chain on which ultimately most shellfish, fish, birds, and marine mammals depend (the exceptions being those that feed mostly on detritus from benthic plants). (See also *Zooplankton.*)
point source	a source of pollution that involves discharge of waste from an identifiable point, such as a smokestack or sewage-treatment plant (Eckhardt 1998)
population monitoring	assessing the characteristics of populations to ascertain their status and establish trends on their abundance, condition, distribution, or other characteristics
prescribed fire	the application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives [FWS Manual 621 FW 1.7]
priority public use	a compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation
private land	land owned by a private individual or group or non-government organization

private landowner	cf. "private land"
private organization	any non-government organization
proposed wilderness	an area of the Refuge System that the Secretary of the Interior has recommended to the President for inclusion in the National Wilderness Preservation System
protection	mechanisms like fee title acquisition, conservation easements, or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintaining species populations at a site (cf. "long-term ~")
public	individuals, organizations, and non-government groups; officials of Federal, State, and local government agencies; Native American tribes, and foreign nations. The term includes anyone outside the core planning team, those who may or may not have indicated an interest in the issues, and those who do or do not realize that our decisions may affect them
public involvement	offering an opportunity to interested individuals and organizations whom our actions or policies may affect to become informed; soliciting their opinions. We thoroughly study public input, and give it thoughtful consideration in shaping decisions about managing refuges.
public involvement plan	long-term guidance for involving the public in the comprehensive planning process
public land	land owned by the local, State, or Federal Government
rare species	species identified for special management emphasis because of their uncommon occurrence within a watershed
rare community types	plant community types classified as rare by any State program; includes exemplary community types
recharge	refers to water entering an underground aquifer through faults, fractures, or direct absorption
recommended wilderness	areas studied and found suitable for wilderness designation by both the Director (FWS) and Secretary (DOI), and recommended by the President to Congress for inclusion in the National Wilderness System [FWS Manual 610 FW 1.5 (draft)]
refuge goals	"…descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable units."—Writing Refuge Management Goals and Objectives: A Handbook
refuge purposes	"The terms 'purposes of the refuge' and 'purposes of each refuge' mean the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or

	administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit."—National Wildlife Refuge System Improvement Act of 1997
refuge lands	lands in which the Service holds full interest in fee title or partial interest like an easement
relatively intact	the conservation status category indicating the least possible disruption of ecosystem processes. Natural communities are largely intact, with species and ecosystem processes occurring within their natural ranges of variation.
relatively stable	the conservation status category between *vulnerable* and *relatively intact* in which extensive areas of intact habitat remain, but local species declines and disruptions of ecological processes have occurred
restoration	management of a disturbed or degraded habitat that results in the recovery of its original state [E.g., restoration may involve planting native grasses and forbs, removing shrubs, prescribed burning, or reestablishing habitat for native plants and animals on degraded grassland.]
restoration ecology	the process of using ecological principles and experience to return a degraded ecological system to its former or original state
riparian	referring to the interface between freshwater habitats and the terrestrial landscape
riparian agricultural land	agricultural land along a stream or river [N.b. We normally base our CCP analysis of impacts on an estimated 50' of land on both banks, unless otherwise stated.]
riparian forested land	forested land along a stream or river
riparian habitat	habitat along the banks of a stream or river [cf. note above]
riverine	within the active channel of a river or stream
riverine wetlands	generally, all the wetlands and deepwater habitats occurring within a freshwater river channel not dominated by trees, shrubs, or persistent emergents
runoff	water from rain, melted snow, or agricultural or landscape irrigation that flows over a land surface into a water body (cf. "urban runoff")
sandplain grassland	dry grassland that has resisted succession due to fire, wind, grazing, mowing, or salt spray [N.b. Characterized by thin, acidic, nutrient-poor soils over deep sand deposits, sandplains primarily occur on the coast and off-coast islands, or inland, where glaciers or rivers have deposited sands.]
scale	the magnitude of a region or process. Refers to both spatial size, for example, a relatively small-scale patch or a relatively large-scale landscape, and a temporal rate, for example, relatively rapid ecological succession or relatively slow evolutionary speciation

Service presence	Service programs or facilities that it directs or shares with other organizations, giving rise to public awareness of the Service as a sole or cooperative provider of programs and facilities
shrublands	habitats dominated by various species of shrubs, often with many grasses and forbs
site improvement	any activity that changes the condition of an existing site to better interpret events, places, or things related to a refuge [E.g., improving safety and access, replacing non-native with native plants, refurbishing footbridges and trailways, and renovating or expanding exhibits.]
source population	a population in a high-quality habitat where the birth rate greatly exceeds the death rate, and the excess individuals emigrate
special focus area	an area of high biological value [N.b. We normally direct most of our resources to SFA's that were delineated because of: the presence of Federal-listed endangered and threatened species, species at risk (formerly, "candidate species"), rare species, concentrations of migrating or wintering waterfowl, or shorebird stopover habitat; their importance as migrant landbird stopover or breeding habitat; the presence of unique or rare communities; or the presence of important fish habitat.]
special habitats	wetlands, vernal pools, riparian habitat, and unfragmented rivers, forests and grasslands [N.b. Many rare species depend on specialized habitats that, in many cases, are being lost within a watershed.]
special riparian project	restoring, protecting, or enhancing an aquatic environment in a discrete riparian corridor within a special focus area
species assemblage	the combination of particular species that occur together in a specific location and have a reasonable opportunity to interact with one another
species at risk	a species being considered for Federal listing as threatened or endangered (formerly, a "candidate species")
species of concern	species not Federal-listed as threatened or endangered, but about which we or our partners are concerned
species diversity	usually synonymous with "species richness," but may also include the proportional distribution of species
species richness	a simple measure of species diversity calculated as the total number of species in a habitat or community (Fiedler and Jain 1992)
State agencies	natural resource agencies of State governments
State land	State-owned public land

State-listed species	cf. "Federal-listed species"
step-down management plan	a plan for dealing with specific refuge management subjects, strategies, and schedules, e.g., cropland, wilderness, and fire [FWS Manual 602 FW 1.4]
stopover habitat	habitat where birds rest and feed during migration
strategy	a specific action, tool, technique, or combination of actions, tools, and techniques for meeting unit objectives
succession	the natural, sequential change of species composition of a community in a given area
surface water	all waters whose surface is naturally exposed to the atmosphere, or wells or other collectors directly influenced by surface water
sustainable development	the attempts to meet economic objectives in ways that do not degrade the underlying environmental support system. Note that there is considerable debate over the meaning of this term…we define it as "human activities conducted in a manner that respects the intrinsic value of the natural world, the role of the natural world in human well-being, and the need for humans to live on the income from nature's capital rather than the capital iteself."
telecommunications	communicating via electronic technology
telecommunications project	any cooperative venture that combines financial and staff resources to develop and use computer-based applications for exchanging information about a watershed with others
terrestrial	living on land
threatened species	a Federal-listed, protected species that is likely to become an endangered species in all or a significant portion of its range
tiering	incorporating by reference the general discussions of broad topics in environmental impact statements into narrower statements of environmental analysis by focusing on specific issues [40 CFR 1508.28]
tributary	a stream or river that flows into a larger stream, river, or lake, feeding it water
trust resource	a resource that the Government holds in trust for the people through law or administrative act [N.b. A Federal trust resource is one for which responsibility is given wholly or in part to the Federal Government by law or administrative act. Generally, Federal trust resources are nationally or internationally important no matter where they occur, like endangered species or migratory birds and fish that regularly move across state lines. They also include cultural resources protected by Federal historic preservation laws, and nationally important or threatened habitats, notably wetlands, navigable waters, and public lands like state parks and national wildlife refuges.]

turbidity	refers to the extent to which light penetrates a body of water. Turbid waters are those that do not generally support net growth of photo-synthetic organisms
unfragmented habitat	large, unbroken blocks of a particular type of habitat
unit objective	desired conditions that must be accomplished to achieve a desired outcome [N.b. Objectives are the basis for determining management strategies, monitoring refuge accomplishments, and measuring their success. Objectives should be attainable, time-specific, and stated quantitatively or qualitatively (FWS Manual 602 FW 1.4).]
upland	dry ground (i.e., other than wetlands)
upland meadow or pasture	upland pastures are areas maintained in grass for livestock grazing; upland meadows are hay production areas [N.b. Meadows may occur naturally in tidal marshes and inland flooded river valleys or, more frequently, at upland sites where vegetation has been cleared and grasses planted. Eventually, meadows will revert to old fields and forest if they are not mowed, grazed, or burned. Grasses in both managed meadows and pastures usually are similar, but pasture herbs often differ because of selective grazing.]
upwelling	a process whereby nutrient-rich waters from the ocean depths rise to the surface; it commonly occurs along continental coastlines
urban runoff	water from rain, melted snow, or landscape irrigation flowing from city streets and domestic or commercial properties that may carry pollutants into a sewer system or water body
vernal pool	depressions holding water for a temporary period in the spring, and in which various amphibians lay eggs
vision statement	a concise statement of what the unit could achieve in the next 10 to 15 years
warm-season grass	native prairie grass that grows the most during summer, when cool-season grasses are dormant
watchable wildlife	all wildlife is watchable [N.b. A watchable wildlife program is one that helps maintain viable populations of all native fish and wildlife species by building an active, well informed constituency for conservation. Watchable wildlife programs are tools for meeting wildlife conservation goals while at the same time fulfilling public demand for wildlife-dependent recreatio nal activities (other than sport hunting, sport fishing, or trapping).]
watershed	the geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and the body of water into which the land drains.

watershedwide education networks	systems for sharing educational information, like curriculum development projects, student activities, and ongoing data gathering; a combination of telecommunications and real-life exchanges of information
well protected	in CCP analysis, a rare species or community type is considered well protected if 75 percent or more of its occurrence sites are on dedicated open space
wet meadows	meadows located in moist, low-lying areas, often dominated by large colonies of reeds or grasses [N.b. Often they are created by collapsed beaver dams and exposed pond bottoms. Saltmarsh meadows are subject to daily coastal tides.]
wetlands	lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. These areas are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted to life in saturated soil conditions. "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water."—Cowardin et al 1979
wilderness study areas	lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation they be included in the Wilderness System (cf. "recommended wilderness") [N.b. A wilderness study area must meet these criteria: generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; has outstanding opportunities for solitude or a primitive and unconfined type of recreation; 3.has at least 5,000 contiguous, roadless acres, or sufficient size to make practicable its preservation and use in an unimpaired condition. (FWS Manual 610 FW 1.5 (draft)).]
wilderness	cf. "designated wilderness"
wildfire	a free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands [FWS Manual 621 FW 1.7]
wildland fire	every wildland fire is either a wildfire or a prescribed fire [FWS Manual 621 FW 1.3]
wildlife-dependent recreational use	a use of a national wildlife refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation (National Wildlife Refuge System Administration Act of 1966).
wildlife management	manipulating wildlife populations, either directly by regulating the numbers, ages, and sex ratios harvested, or indirectly by providing favorable habitat conditions and alleviating limiting factors

wildlife-oriented recreation	recreational activities in which wildlife is the focus of the experience [“The terms ‘wildlife-dependent recreation’ and ‘wildlife-dependent recreational use’ mean a use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.”—National Wildlife Refuge System Improvement Act of 1997]
working landscape	the rural landscape created and used by traditional laborers [N.b. Agriculture, forestry, and fishing all contribute to the working landscape of a watershed (e.g., keeping fields open by mowing or by grazing livestock).]

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Appendix A. Responses to Substantive Comments Received on draft CCP/EA of Chesapeake Marshlands NWR Complex

USFWS

Sunset on the refuge

We received comments from 4 Federal agencies, a Maryland State Representative, 2 state agencies, 4 county agencies, 15 non-governmental organizations, 7 businesses and twenty-two private citizens.

Agency, Organization, and Individual Responses

Comments were received from the following agencies, organizations, and individuals:

Federal Officials: None

Federal Governmental Agencies

U.S. Army Corps of Engineers, Baltimore District Office
USF&WS Chesapeake Bay Field Office
U.S. Geological Survey, Eastern Geographic Science Center
U.S. G. S. Patuxent Wildlife Research Center

State Officials

Delegate Mary Roe Walkup, Legislative District 36, The Maryland House of Delegates

State Agencies

Wildlife Heritage Service, Maryland Department of Natural Resources
Maryland Farm Bureau, Inc.

County Officials and Agencies

Dorchester County Council Member
Dorchester County Tourism Department
Heart of Chesapeake County Heritage Area
Dorchester County Forest Conservancy District Board

Private Organizations

The Nature Conservancy, Maryland/District of Columbia Chapter
Friends of Blackwater National Wildlife Refuge, Inc.
Maryland Waterfowlers Association (2)
Chesapeake Bay Foundation
Association of Forest Industries, Inc.
Audubon MD-DC Chapter
American Forest Foundation, Forest for Watersheds and Wildlife
Conservation Fund (2)
Chesapeake Wildlife Heritage
Safari Club International, Chesapeake Chapter
Maryland Forest Association, Inc.
National Wild Turkey Federation, Maryland Chapter
American Kennel Club
Wicomico Environmental Trust
Migratory Bird Advisory Committee of the State of Maryland

Business Interest and Individuals

Dorchester Lumber Company, Inc.
Johnson Lumber Company, Inc.
Dorchester Stags Hunt Club
Besley & Rogers, Inc.
Madison Bay Hunt Club
Brooks Barrel Company, Inc.
Parker Forestry Services, Inc.

We have organized the comments that we received into broad categories and topics. Our responses to the comments follow.

Planning Process Comments

Some individuals felt that the Service did not adequately communicate or hold enough coordination and information meetings between the time of the public scoping meetings in 1998 and the release of the draft report in June 2005.

Response: We agree. Hindsight shows that we should have held additional meetings during the planning process to keep the public informed and up-to-date with our progress. We regret that we didn't make this effort. Completing the EA/CCP was our main concern and focus.

As we prepared for the public meetings and public review of the draft CCP/EA, the Service experienced difficulties in the printing and release of the draft report after the Notice of Availability was issued in the Federal Register. As a result, we announced an extension to the comment deadline to ensure that the public had adequate time to respond to the draft EA/CCP. Because of the large size of the main report and appendices, only the Land Protection Plan (LPP) and Highlights Summary were mailed to adjacent landowners. This unfortunately resulted in the LPP being mistaken as the Comprehensive Conservation Plan, and only a few people had the opportunity to read the main report prior to our public open house meetings. Most people did not take advantage of accessing the report via the internet. Refuge Manager Carowan did meet with and brief Dorchester County officials and private non-profit land conservation organizations before the public open house meetings. Additional meetings were held with the Friends of the Nanticoke and Wicomico Environmental Trust. Refuge Manager Carowan and Regional Director, Marvin Moriarty also met with members of the local forestry industry.

The last public scoping meetings took place in 1998 and of the 44 agencies and organizations "involved" in the development of the plan; the largest agricultural interest group in the state was not included.

Response: We disagree. Members of the Farm Bureau attended our scoping meeting in Hebron. Furthermore, a significant effort was made to specifically target farmers within the land protection focus areas to ensure that their concerns and issues were properly heard. All farmers in the Dorchester County Nanticoke focus area, for example, were invited to a special meeting to discuss the CCP process in early 1998, prior to the formal scoping meetings. Landowners who farm in Wicomico County's focus area were also targeted to ensure they were aware of the planning process. Since agriculture was not an issue identified at the scoping meetings and since the Service is not proposing to remove agricultural lands from production, there was no concern expressed for our planning process. Unfortunately, some individuals interpreted that the LPP includes a plan to "condemn and take" farmland. This is not the case.

Why didn't the Service go direct to the Farm Bureau? Farm land is regulated now and is not causing impacts.

Response: We regret that we did not contact the Farm Bureau before releasing the draft EA and our land protection plan. However, since potential impacts to farmland were never identified as an issue during the public scoping meetings, this issue did not figure prominently in the planning. Most of the lands identified for protection were either forestlands or wetlands. Furthermore, the agricultural lands, whether privately or publicly owned, will continue to be farmed.

Management of Refuge Forestlands

Members of the forest industry expressed concern about the lack of forest management and the resulting adverse economic and social impacts on the local community. This concern was heightened because of the expressed fear that additional lands would be acquired and no active forest management would continue as in the past.

Response: We have proposed active forest management as an integral part of our overall habitat management to improve and maintain forest health and composition to assist in the recovery of the Delmarva fox squirrel and habitat enhancement for forest-interior-dwelling bird species. Our proposal to manage our forest is based on the principle of "Wildlife First" and not economic, sociological or historic principles. The type(s) of silvicultural prescription(s) required to achieve our wildlife management objectives depends on the wildlife species being managed for. Removal of commercially harvestable trees is normally done under contract with local timber interests. Special Use Permits are written to protect refuge resources, and operations are monitored by refuge staff. Annual management prescriptions will be prepared that detail the specifics of an operation and the management method(s) to be employed. The effects of prescriptions for timber stand improvement, regeneration harvest, prescribed burns, strategic land protection and reforestation are found on pages 4-61 through 4-89 of the draft CCP/EA. Active forest management on refuge lands would create opportunities for timber companies to bid on the timber or the silvicultural work to be performed.

What is the difference between forest management to achieve wildlife management objectives versus timber production?

Response: The Service is the trustee for our nation's fish and wildlife resources. Our responsibly is to "wildlife first" and not timber production as defined by the National Wildlife Refuge System Improvement Act of 1997. We are in favor of sustainable forestry practices and we are not proposing to take forestlands out of production. However, our refuge forestry management is directed to specific wildlife management objectives such as delisting the Delmarva fox squirrel, protecting unique or critical habitat types, developing connections with fragmented habitats, providing contiguous healthy forests to support forest interior dwelling migratory birds, etc. To achieve these objectives, we will utilize the appropriate silvicultural practice and a byproduct of these practices will be timber production.

The Need for Additional Land Protection (Land Protection Plan)

While some local citizens expressed support for additional land acquisition, others voiced concerns relating to matters such as the use of condemnation, economic impacts such as reduced timber production, lost tax revenues, additional regulations and restrictions on traditional activities as a result of Refuge expansion, endangered species population expansion, and private landowner rights. Others welcomed a federal presence and opportunities as one more tool to provide long-term protection to these extremely resource rich ecosystems. Conservation partners voiced strong support for Service involvement in a cooperative effort to identify land protection priorities, with Service acquisition of lands and development of conservation agreements where appropriate.

Response: The need for additional habitat and land protection was a topic of significant discussion. The National Wildlife Refuge System and individual refuges, such as those in the Chesapeake Marshlands Complex, were created for, and are representative of, the widest public benefit consistent with our nation's

natural resource laws and policies. Habitat protection is the foundation of our national wildlife refuge system. Acquisition of additional lands and development of conservation agreements in the vicinity of the refuge and along the Nanticoke River corridor are necessary to fulfill Service and refuge goals for managing threatened and endangered species, waterfowl, other migratory birds, and fisheries; providing compatible recreational and educational opportunities; and ensuring public access for the future. Lands in the immediate vicinity surrounding Blackwater NWR and along the Nanticoke river corridor are known to support both federally- and State-listed rare, threatened, or endangered plant and animal species; unique ecological communities; significant concentrations of waterfowl, wading birds, shorebirds and other migratory birds; shellfish and finfish; and resident wildlife. The importance of the area's unique natural resources has long been recognized by federal and state resource management agencies, private conservation organizations, land trust, and local citizens. Ultimately, protecting biological diversity requires commitment to habitat protection, which is best achieved by commitments to land acquisition and stewardship. The Service can ill afford to stand still in the face of increasing urban development and further fragmentation of an already limited forest habitat. It is further emphasized that the Service is but one player and a landowner can sell to whomever he/she wants. We are not the only potential land buyers on the Eastern Shore. We know that at some point in time a person may want to sell or place their property in a conservation agreement. A landowner also has as much right to place his/her lands into conservation as to sell for development. Opportunities to protect habitat of significant ecological value in Maryland, and specifically the Eastern Shore, is rapidly diminishing, as acres are lost to development every day.

Why is the list of landowners identified in the Land Protection Plan (LPP)?

Response: We apologize to those that would have preferred not to be on the list. The LPP is an agency document, required by agency policy to provide the landowners and other interested local public officials with an explanation of who, what, when, where, and how land protection actions are anticipated to occur. In this respect, the LPP can be thought of as a "procedural notification." Agency policy mandates that we identify specific land parcels and ownerships, and prioritize these parcels. The landowner is under no obligation just because his/her name and parcel is identified. The plan simply identifies areas of major conservation significance that can benefit from conservation protection measures.

Land ownership information is on public record, and can be obtained at the county/local tax assessor's office and state planning office. The State Department of Planning sells this information to the public. Service policy requires that the owner's name, parcel, and map number be identified. The LPP is an information report to the landowner that explains our land acquisition program policies and procedures. However, in an effort to be responsive to landowners' wishes, we will remove the names from the LPP in the final EA/CCP.

What public uses will be allowed on newly acquired land?

Response: Public use for any given land parcel is evaluated on a case-by-case basis, and must be compatible with the wildlife and habitat protection. The Service recognizes and promotes six types of wildlife-dependent public uses: wildlife observation, photography, environmental education and interpretation, hunting and fishing. New acquisitions are closed to the public until officially opened for public use.

Why does FWS need to acquire lands from the private sector when many of the refuge neighbors are already managing their lands in sustainable ways?

Response: We don't have to acquire lands that are currently being managed in the private sector to benefit the Service's wildlife management objectives. However, if a landowner is leaving the area or changing the way that they manage their land, the Service would like to see associated resources on these lands protected. The Service will be able to work with the landowner to preserve the wildlife management objectives only if we have an approved LPP. Congress has mandated the Service as trustee of our nation's fish and wildlife resources. As part of our affirmative trust responsibilities, we must ensure the ecological health and integrity of our national wildlife refuges. Land protection enables us to fulfill our mission and

refuge purposes. Protection and maintenance of a refuge's integrity-diversity-health are translated into actual actions through management objectives and strategies such as our land protection plan.

Will you partner with NGO's to protect lands identified in the LPP? Do you have a policy that would limit or place restrictions on NGO's?

Response: Our land protection planning was accomplished with full participation and knowledge of our partners. However, we are not looking at buying out another partner at a higher price. The importance of the nonprofit organizations in acquiring and preserving important high priority lands and waters is acknowledged. However, the Office of the Inspector General has long been concerned that the Federal taxpayers are receiving full value for costs incurred to acquire lands through third party transactions. The Nanticoke River land protection plan was a collaborative process involving state and private land conservation partners.

Will refuge expansion promote or influence landowners to sell to a developer?

Response: There is no indication that this will be the case. Studies do show, however, that residential home values generally increase in the immediate vicinity of a refuge or otherwise protected lands. Many people prefer homes next to or abutting protected/conservation lands, and real estate agents use this fact as a marketing tool. There is no evidence that landowners are influenced to sell just because of the presence of a refuge, but it is a definite positive selling factor in terms of value when owners do want to sell. It's the landowner's decision to make. An individual's family, health or financial situation generally dictates the decision to sell or not to sell.

Why does the Service need to acquire more lands and why can't acquisition be accomplished by private organizations and state conservation/natural resource agencies?

Response: The Service is mandated by Congress and bound by international treaties and statutory obligations to protect and conserve waterfowl, other migratory birds, and endangered and threatened species for future generations to appreciate and enjoy. The Refuge Improvement Act includes a provision whereby the Service is instructed to "strategically grow" the Refuge System. The Service is designated as the trustee of our nation's fish and wildlife resources. The Blackwater Refuge is the oldest established national wildlife refuge in the region, and as such has played a significant role in helping to conserve and protect the Eastern Shore's waterfowl and natural resources. Approval of the LPP and CCP gives the Service the opportunity to assist landowners with implementing conservation measures to continually protect our trust resources. Land acquisition and other land protection measures have been, and will continue to be, accomplished by private and state organizations, but no single organization or agency has the resources to provide the overall protection necessary to achieve all our management objectives. Forest interior dwelling species, for example, require large, contiguous parcels of forested habitats. In many cases, only additional land protection can achieve the objective to provide these large acreages.

Please explain the statement; "Service policy (page xvi, LPP) is to acquire land only when other means, such as zoning or regulation, of achieving program goals and objectives are not appropriate, available, or effective?"

Response: Planning for land acquisition is initiated with the identification of a need to meet resource objectives that require a real property base. Full consideration is given to existing regulations, or zoning. If it is determined that the lands are adequately protected, the Service will not necessarily pursue its purchase. If fee title is required, consideration may be given to extended use reservations, exchanges, or other alternatives that will lessen the impact on the owner and the community. It cannot be emphasized enough that local laws, zoning regulations, and ordinances are always subject to change. No regulations exist that manage or control public use activities. The issue of annexation is a major one for some counties. Currently, there are no county guidelines or provisions regarding annexation rights, and municipalities are

readily annexing lands for development. Throughout the nation, and certainly in the northeast, the prevailing attitude towards growth and development is one of being infinite and inevitable. Without Service authority and refuge status, regulations relating to the development of critical habitat and wetland alteration could be proposed and passed.

The Ecological Services branch of the USFWS points out that one of the Service's most highly successful mechanisms of conserving biological diversity is land protection. The CCP's land protection program outlines additional acreage that will enhance the recovery of the federally endangered Delmarva fox squirrel (DFS).

The CCP recognizes the importance of protecting approximately 11,300 acres of forested habitat (5,000 forested acres at Blackwater and 6,296 acres along the Nanticoke River) to secure a majority of the intact forest within the Blackwater NWR watershed, as well as the creation of forest corridors along the Nanticoke river, to link the private, state, and federal land protection efforts. Virtually all of this forest is currently occupied by DFS or is considered suitable DFS habitat. Protection of this habitat will greatly contribute to the eventual recovery of the DFS and its eventual removal from the endangered species list.

Response: We agree that the land protection component of the CCP will enhance DFS habitat and is a key component to realizing many of our refuge goals and objectives.

Some felt that the release of the Land Protection Plan was a sudden announcement to a limited audience of targeted landowners of the refuge's plan for expansion without affording an opportunity to learn of the plan's specifics. Certain stakeholders believe that to undertake an expansion of this magnitude consisting of the goals stated throughout the Plan, public input and buy-in is essential. One group urges that the Service redraft the Plan with greater opportunity for significant input from the agricultural community and various other stakeholders.

Response: The release of the Draft EA/CCP and land protection plan was announced in the local and regional news media. Over 2,000 letters of notification were mailed and over 400 copies of the land protection plan (LPP) were mailed to affected landowners as required by Service policy. The LPP is an appendix to the DEA/CCP and is an integral part of the overall proposed refuge management plan. It certainly does not represent "the plan" in and of itself. The LPP is an agency document, required by policy, to inform landowners of Service land protection interests and plans. Typically we expect the LPP to reduce public speculation and eliminate misunderstanding of Service land protection initiatives.

The LPP is purposely focused in distribution to affected landowners. The LPP is a tool to redefine the geographic extent of the area where the Service may engage in discussions with willing landowners. The LPP identifies areas of exceptional conservation values that are important to the Service and Refuge missions, and notifies the landowner(s) that the Service would be willing to work with the landowner to purchase the land or a conservation easement on the land, if the owner is interested. Any relationship between the landowner(s) and the Service is strictly voluntary. There was some misinterpretation that the LPP is a notice of immediate expansion of the refuge through condemnation. Condemnation will not be used to protect lands.

The LPP is limited in scope to the identification of parcels of land that contain exceptional conservation values. In this case, it was produced in conjunction with the CCP and EA. The CCP/EA represents the first official written document for public review. As such, the Draft EA was more widely distributed and actively publicized through a Notice of Availability, news articles, public meetings or hearings, landowner contacts, and meetings with local organizations and elected officials. Internet web site addresses were provided where the entire report could be accessed and Compact Disks of the full report were available on request.

We agree that public input and buy-in is essential. That is the reason for the public open house meetings and review comment period given for the Draft EA/CCP. The LPP is a component of the main refuge management plan, not the plan itself. Habitat and land protection are the foundation of our national wildlife refuge system. Our "goals" are wildlife resource management oriented, and emphasize the protection of Federal trust resources such as endangered and threatened species and migratory birds. Since the Service is not proposing to take agricultural lands out of production and since acquisition of any lands identified is on a voluntary (willing seller) basis, we see no need to redraft the land protection plan. Many organizations, groups, and private citizens have stated and believe that Service acquisition and management is vital to ensuring the long-term protection of natural habitat and fish and wildlife resources of the Eastern Shore. The economic importance of agriculture to Dorchester County is acknowledged on page 3-191 of the draft EA/CCP. Despite the Rural Legacy Program and other incentives, significant farmland is still being lost to residential development.

A non-governmental organization believes that community-based conservation is critical in its conservation efforts. We feel that the Land Protection Plan of Alternative B works toward this goal by supporting and maintaining working landscapes within a matrix of high quality natural resources. The real estate industry is booming as development spreads from the Washington/Baltimore corridor over the Bay Bridge to the Eastern Shore of the Chesapeake Bay. We need the USFWS to be an active and effective partner in protecting the landscape. We feel this can only be done under preferred alternative B of the EA.

Response: We agree and appreciate the support.

While we applaud the use of easements in so much that private ownership is retained, we remain very concerned about the lack of a uniform policy guiding the specific language in the easements. Losing the legal ability to practice forestry according to silvicultural precepts…..is unwanted regardless of the source.

Response: Conservation easements are among several essential tools used to protect the integrity of natural resources. Easements by nature have to be flexible and developed on a case-by-case basis. The specific details of what should or should not be included in an easement are agreed to by the holder of the easement and the owner of the property. Whether or not a use, such as active forest management, is retained or not is negotiated at the time of the easement creation.

It is of great concern to us that many landowners with very short planning horizons may opt to maximize their immediate incomes by "selling off" their forestry rights at the expense of providing meaningful forest management in the future.

Response: The landowners certainly have that right and there is evidence that this is happening already. Recent sales to the private sector reveal that not all buyers intend to continue with forest management as an investment. Rather, the new owners appear to be more interested in recreational value as oppose to sustainable forestry management or at least the annual harvest is much reduced. Many landowners are not interested or concerned with the monetary value of the land but rather the land itself. There are numerous examples of landowners that opted to sell a conservation restriction for substantially less than they would have received from developers. The Service feels that the proposed refuge management plan and land protection plan provides the landowner options to generate a source of revenue for rights they may chose to sell while maintaining lands in private ownership, protecting conservation values and retaining a tax base. Ultimate ownership may or may not be the Fish & Wildlife Service.

One association commented that they were encouraged by public statements that (1) sustainable forestry management will be enhanced, consistent with Service's mandate to manage for wildlife and 3rd party certification (SCI and/or FSC) at Blackwater NWR; (2) sustainable forestry management will be a key tenet in future land acquisition efforts by the Service through binding easement

language that encourages the retention of timber harvesting rights consistent with a forest stewardship plan.

Response: We believe that the sustainable forest management activities that you mention are accurately reflected in the Final CCP as components of our future habitat management efforts.

The Use of Eminent Domain (Condemnation) to take Private Lands

Condemnation was undoubtedly the most feared concern expressed during the public open houses. Meeting attendees also feared that if condemnation happened, they would not be adequately compensated for the real value of their land.

Response: Condemnation is not being proposed nor will it be proposed. Nevertheless, the Service is required to advise the public that condemnation is authorized for land protection. The U.S. Fish and Wildlife Service, like all governmental agencies, has been given the power of eminent domain, which allows condemnation as a means to acquire lands for the public good. If the Service didn't mention or provide discussion on this topic, it would be looked upon with suspicion. Yet, when we openly discuss eminent domain, the reaction is immediately that the government is going to take our land without consent. In the early 1980's, the Service initiated a land protection planning effort. The "perception" of landowners then, as now, was that we were going to condemn lands. Condemnation was never considered, but the idea of predetermining a final boundary line on paper was not well received by County officials and the local public. The end result was that the Service proceeded to protect properties on a case-by-case, willing landowner basis only. This met the County's approval, and the same practice will continue as described in the preferred alternative. Only when a landowner desires to implement a conservation practice will the Service take action to assist in protecting the values the Service is charged to protect.

Blackwater NWR has used condemnation to acquire lands only when requested by the landowner to resolve unclear titles or differences in value. This is always done at the landowners' request. The Service (and any other governing agency) is required by law to pay fair market value or "just compensation." Again we emphasize that condemnation is not proposed, and will not be used in conjunction with the refuge's proposed land protection plan.

Support for Specific Alternatives

Alternative A is your best choice. Most of the area you propose to protect from development is already protected by a host of state and federal regulations – most notably, Maryland's Critical Areas Law and state and federal wetland regulations.

Response: Alternative A, Current management or status quo is not adequate and does little to ensure the long-term protection of the refuge fish and wildlife resources. The purpose of this alternative is to provide a basis of comparison for what the Refuge Improvement Act is asking the Service to do. This is a long-term look at ecological based management and actions that will satisfy Congress and the Act's mandates. Comments received during the public scoping meetings identified many needs and concerns for the future of this refuge, and we are trying to respond to those needs. Furthermore, Alternative A, from the forest industry's perspective, does not include any forest management. We believe your comment must be related then only to additional land protection efforts. It should be noted that Maryland's Critical Area Laws have to date not helped protect the upper Blackwater watershed from development.

Eight individuals and 6 agencies/groups expressed blanket support for alternative B.

Response: Comments noted.

Hunting and Trapping

Why don't we have trapping for red fox and raccoon on Martin Refuge?

Response: Red fox trapping has been permitted on Martin Refuge historically, and may again be permitted in the future if there is a need. A Special Use Permit must be issued if the public is authorized to trap foxes and raccoons.

You propose wild turkey and residential goose hunts. When will the final decision be made and who will prepare any additional necessary plans.

Response: All documents required to officially open the refuge to waterfowl and turkey hunting were submitted to the Director in January 2006. The Public Notice will be published in the Federal Register in September or October 2006. If subsequently authorized by the Director, waterfowl hunting will be permitted as early as December 2006 and turkey hunting will begin in the spring of 2007.

What amount of acreage will be made available for hunting waterfowl?

Response: Congress has authorized the Service to permit waterfowl hunting on a maximum of 40% of a refuge established for migratory birds. Potentially, approximately 20,000 acres could eventually be open. Realistically, up to 5,000 acres may be opened immediately.

Local hunt clubs have long-term leases. Some landowners are concerned that if the Service obtains easements or acquires lands in fee-title, revenues generated by the clubs will be much reduced.

Response: If easements are used as the land protection mechanism, hunting rights can be retained by the landowner and leases can continue, generating income for the landowner.
If the Service acquires lands in fee-title, private hunting rights cease and the landowner no longer will be able to lease his/her property. However, this does not mean a loss of revenue for the local economy. Refuge lands are public trust resources, and the Service is congressionally mandated to provide public hunting opportunities. Revenues from refuge hunts and recreation programs directly support refuge public use programs and the local and regional economies. The annual deer hunts at Blackwater Refuge have generated approximately $40,000 annually for the past two years, and the more than 2,500 hunters spend thousands of dollars locally in support of the local economy (an estimated $250,000 to $450,000, annually in retail spending). In fact, the public use programs provide an estimated $15,000,000 a year to the local economy (gas, food, lodging, etc.). Private land lease revenues, on the other hand, are pocketed by the owners and do not go into the local economy, nor are they nearly as significant in terms of dollars generated. The revenues generated by hunting clubs, if made known and available, are factored into our land appraisals prior to any acquisition.

Wildlife and Heritage Service would encourage you to include the annual youth turkey hunting day (normally the Saturday prior to the opening of the regular spring season) in your range of dates that turkey hunting will be allowed. The statewide regular spring gobbler season was expanded to 5 weeks in 2002, and we encourage CMNWR to provide opportunity throughout the duration of the current season.

Response: Changes to include youth turkey hunting and extended seasons in accordance with state regulations have been made in the CCP.

We were also encouraged by Maryland Wildlife and Heritage Service to consider allowing hunting for resident Canada geese during the September 1-15 season. (Not just a spring hunt as proposed in Alt. B) Additionally, we received strong support for the proposal to open new parcels to waterfowl hunting.

We were asked to revise the proposal to read "at least 40% of newly acquired land," and include language that will examine all current tracts for opportunities to provide waterfowl hunting.

Response: We have re-evaluated fall hunting of resident Canada geese, but our Integrated Wildlife Damage Management Control Program is aggressively pursued until the state's September 1 opening date and will significantly affect hunter success on certain areas. The preferred alternative will propose authorizing hunting of RCG in the fall in areas open to general waterfowl hunting. We will also amend the section on waterfowl hunting to clearly indicate areas (both newly acquired as well as existing acreage) where waterfowl hunting will be allowed. The point of not regulating waterfowl hunting on a parcel by parcel basis is noted, and both existing as well as new lands will be evaluated.

Alternative B provides for muskrat trapping only. WHS would encourage you to include the trapping of other furbearer species in accordance with state regulations.

Response: Alternative B should have also included trapping of other furbearers, including red fox, raccoon, opossum, etc.

We received a number of letters in support of increased waterfowl and deer hunting opportunities on Blackwater Wildlife Refuge and other public lands.

Response: Comments noted.

A number of individuals expressed anger and frustration at the proposal to increase hunting opportunities. This proposal they claim, "flies in the face of the word refuge." One individual expressed dismay that resident Canada geese would be hunted.

Response: The National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act) lists hunting as one of six priority, wildlife-dependent public uses to receive enhanced and preferential consideration in refuge planning and management. In addition to hunting, other priority uses include fishing, wildlife observation and photography, environmental education and interpretation. Our mandate is to provide high-quality opportunities for these priority uses where they are compatible with respective refuge purposes, goals, and other management priorities.

Although individual opinions about the appropriateness of hunting on the refuges are important, the Refuge Improvement Act requires that we give preferential consideration to the six priority, wildlife-dependent uses. We are also concerned about the potential for hunting to impact other priority uses. For this reason, only certain areas of the refuge will be opened. There appears to have been some confusion about where we are proposing to allow hunting. We have outlined the areas where hunting is to be allowed on the maps that are included as a part of the CCP.

The problems that arise from overabundant resident Canada goose populations include damage to private property and potential for the transmission of disease to humans and other wildlife. The Service completed an Environmental Assessment of the problems these nuisance species were causing, and chose to implement an integrated wildlife damage management plan to keep resident geese from destroying the native habitats that our wildlife depend on. This plan utilizes non-lethal actions as much as possible, however lethal control methods do become necessary. When lethal methods are used, they are restricted to live capture and euthanasia in accordance with the American Veterinarian Association standards, and the birds are donated to feed the homeless.

Socioeconomics

There were commenters that expressed their thoughts that there are serious deficiencies in the socioeconomic analysis of the LPP. These individuals took exception to the statement that "we anticipate no significant adverse socioeconomic or cultural impacts."

Response: We discuss socioeconomic impacts and existing socioeconomic conditions in Chapters 3 and 4 of the draft EA/CCP. It is not the purpose of the LPP to provide a detailed impact analysis. We believe there will be little to no adverse socioeconomic impacts simply because the Service acquires additional forest lands since timber harvest will continue and because the overall impact to the total forested landscape is relatively small.

In addition, Refuge Revenue Sharing payments provide contributions to the local governments in lieu of taxes generated from forest and agricultural lands. The refuge is a destination site for tourists and generates significant revenues that could equal or offset any economic loss from changes in timber or agricultural harvests. The refuge is reported by the Dorchester County Department of Economic Development to generate $15 million annually to the local and regional economies. (Read in more detail Chapter 3, pages 3-186-202 of the Draft EA/CCP. Additional socioeconomic discussion related to our land protection strategy and public use can be found in Chapter 4, Consequences, pages 4-185-195 and 4-199-204.) Since we are proposing an active and aggressive forest management plan with contract opportunities afforded the local timber/forest industries, no major economic impact is foreseen. The Service will be working in partnership with the local forest industry to ensure sustainable forestry continues when compatible with our wildlife mission.

Retaining "open space" is a shared goal. However, without revenue generation, these same "open space" lands run the risk of losing their contributory function.

Response: Our analysis indicates that the contributory function will not be lost since active forest management will continue (and actually expand to lands not previously managed). Also additional revenue will be generated because of the uses attributed to the National Wildlife Refuge System's management of wildlife-dependent recreation. Currently, the Refuge contributes approximately $500,000 in tax revenues and generates about $15,000,000 to the local economy annually.

Plan Implementation

Has money been allocated for implementing the plan's recommendations?

Response: Annually, the President requests budget to operate the Federal government, which includes funds for national wildlife refuges. The Service is actively involved in recommending budget priorities to the President. Ultimately, it is the decision of Congress' Authorization and Appropriations Committees and the President to approve funding.

When the Service acquires new parcels of land, how will that land be managed? How often can the plan be revisited?

Response: Management plans are not done on individual parcels. The land will be managed in accordance with the goals, objectives, and strategies outlined in the final CCP. In addition, the refuge implements a number of "step-down" management plans that provide additional information about the role of each parcel in various aspects of refuge management. For example, an annual detailed prescription for forest management will be developed that will address what we would cut, where, and how much. The method of timbering would also be identified. Step-down plans can be revised and updated as necessary if new

information dictates. Management activities on almost all new properties are simply incorporated into existing plans. The CCP is designed to be a 15 year plan.

One individual commented on the need for emergency preparedness. The refuge should be prepared to deal with emergencies ranging from weather related to terrorist events.

Response: The refuge maintains a Continuity of Operations Plan. This plan outlines the conditions that this individual recommended and is updated as needed.

Public Uses

What is the Service's definition of public use? If I agree to an easement or some other conservation agreement, will you demand public use?

Response: The Service recognizes six priority, wildlife-dependent public uses: wildlife observation, photography, environmental education, interpretation, hunting, and fishing. No, the Service will not demand public use as part of an easement or any other conservation agreement. All easements are negotiable. Only the rights the landowner wishes to provide as a part of the easement are subsequently managed by the Service. If you as the owner/seller don't want public use on your property or don't want certain uses to occur, then these conditions would be stated in the easement. The buyer, i.e. the Service, then has a decision to make on whether or not to purchase the easement with such a reservation or provision incorporated. The Service would not seek easements for public use purposes only. The main priority is to preserve enough habitats to support the wildlife goals and objectives of the refuge.

Preserving public access to this land is vital if public support is to be gained. Adding emphasis to educational aspects, especially for youth, must be central to that as a long term goal. Many of the values of the rural life of years past, including an appreciation for the natural order of things, are no longer easily understood or supported on a daily basis from the perspective of urbanites. It is vital that we provide the physical and intellectual tools to enable them to develop a true sense of personal relationship with their environment. This means operating properly staffed and located facilities in proximity to the habitat so that information presented can be seen in action in the wild.

Response: We agree and believe that the management goals and objectives outlined in the CCP provide for the aspects of rural life that you mention.

Other Regional Plans

The Corp's May 2005 Baltimore Harbor and Channels, Dredged Material Management Plan and Draft Tiered Environmental Impact Statement (DMMP EIS) documents the regional benefits of using dredged material from the mainstem channels for marsh restoration in Dorchester County. I suggest that you specifically reference this document.

Response: We were not aware of this draft document when our draft EA was prepared. Thank you for bringing it to our attention and we reference it in our final CCP on page 4-54.

Marsh Restoration

The Corps commented that the CCP/EA ….omits consideration of two potentially important stressors to the marsh system that may require consideration in formulating future landscape-scale marsh restoration: 1.The potential for hydraulic/hydrologic restrictions caused by the three mile long

Shorters Wharf (Maple Dam) Road causeway. The road may limit sheetflow across the marsh surface and may cause reduced organic matter production by marsh vegetation upstream of the road. 2. Prescribed burning of the marsh at rates greater than natural fire frequency. Frequent burning disfavors fire-intolerant marsh plant species …..while favoring fire tolerant marsh plant species that are more palatable as wildlife food. Burning frequency should be evaluated to determine direct and indirect impacts on marsh stability, and optimal burn frequency to promote marsh stability should be identified for potential use in marsh management.

Response: The DEA is not required to assess all aspects of a landscape-scale restoration of the marsh ecosystem. It is a programmatic document that establishes the management direction for the refuge for the next 15 years. Accordingly, it recognizes the objective to restore the marshes to the 1933 levels. Specifically, how that will occur will obviously require significant investigation and evaluation in the future. With that said, the Service is clearly aware of the hydraulic/hydrological problems associated with Shorters Wharf Road, and can ensure that these issues will be part of a future NEPA action that will address proposed alternatives for landscape-scale restoration. As to the return fire interval for prescribed fire management, this issue has been evaluated and assessed in the Service's EA and accompanying approved Fire Management Plan, and accordingly the DEA was not required to repeat this information. The documents that discuss fire management issues are available upon request as noted in the DEA. The Service is continuing to implement numerous studies to determine optimal return fire intervals required to achieve the refuges' multiple management objectives.

Other Permits

Corps -Discharge of any dredged and/or fill material into waters of the U.S. associated with marsh restoration at Blackwater NWRT not undertaken as part of an authorized Corp's civil works project will likely require a Dept. of the Army permit pursuant to Section 404 of the Clean Water Act.

Response: The refuge is familiar with the regulatory requirement and will obtain all necessary permits.

Threatened and endangered species

The CCP is an ambitious blueprint for achieving conservation objectives for federal trust species and habitats of international, national, regional, and local importance. The CCP is greatly strengthened by directly linking existing partnerships and collaborative efforts within the Chesapeake Bay watershed. Proposed public use developments, especially environmental education and interpretation, will increase the public's awareness of and knowledge about DFS. The Refuge's proposal to implement good science with inventory, monitoring, and research should benefit the DFS.

Response: DFS management and ultimate recovery is a primary goal for the CCP.

We note with pride, the continued existence and expansion of both the Delmarva fox squirrel and Bald Eagle in our region dominated by private stewardship activities. Removing these lands from private ownership or management for safeguarding certain key species is not in our minds a "fair trade." True, the plan calls for a strict adherence to a "willing buyer and willing seller" paradigm, but lost from the discussion is the central issue of quantifying the economic loss our regional community will face from the diminishment (albeit gradual) of our second most pre-eminent natural resource-based industry. This discussion should include quantification of the expected gain to the Refuge's "trust resources" and how they will then parlay into benefiting the regional economy and quality of life.

Response: Active forest management will be practiced on refuge lands, and there should be no significant impact to the forest industry and local economy from changes in timbering practices. Also there is

absolutely no guarantee that the historical performance and continued existence of stewardship the private landowner mosaic has provided, will continue. In fact, there are indications now that the current private ownership mosaic is breaking down throughout the county and the Eastern Shore. Forestry practices, if done on a sustainable basis, can actually enhance the carrying capacity of properties for certain forms of wildlife life as you note. As noted repeatedly, the point the Service is making is not that we have to own all these lands, but we, like the forest industry, wish to be at the table should the current land management practices change. To do that, we must notify the landowners that their properties are important to the Service, and that we are willing to discuss protection methods when they are. The threat that the forest industry perceives is simply not there.

Complexing Refuges

A member of the Maryland House of Delegates comments that the complexing of Eastern Neck NWR under the Chesapeake Marshlands NWR Complex was made public on May 3, 2005, in the Federal Register announcing this CCP. Finalizing this significant action without prior public notification indicates a flawed interpretation of Public Law 105-57 and its requirement for public participation.

Response: The administrative decision to make Eastern Neck NWR the administrative center for the management of the Cheaspeake Island Refuges is categorically excluded from the NEPA process. A separate CCP will be prepared for the management of Eastern Neck NWR as required by Public Law 105-57.

Please register my comments on this Draft CCP as an official objection to the document's designation of Eastern Neck NWR as a unit of the Chesapeake Marshlands NWR Complex.

Response: So noted.

Staffing

The representative from the Maryland House of Delegates takes exception to the staffing increases proposed by the Chesapeake Marshlands CCP that will levy a heavy financial burden on taxpayers. "It is difficult to accept that these alternatives were the results of open dialogue with the public, and that such grassroots involvement did not offer more fiscally responsible and progressive solutions to meet the refuge system's goals without increasing the public debt."

Response: The proposed increases in staffing are a reflection of the public recreational and access opportunities demanded by the public at our planning scoping meetings held in 1998 and continually received throughout the year by refuge visitors. At this time, given the existing budget considerations, it is unclear when these positions would be funded. The concept of complexing will help resolve concerns by effectively sharing resources among all refuges within a regional geographic area. Complexing helps stretch limited funding and reduces the fiscal impact to the taxpayers. The 1997 Refuge Improvement Act also calls for the enhancement of the Big 6 priority public uses on national wildlife refuges. Increased visitor uses, services and facilities always require additional staff and funding.

Rather than centralizing refuges into complexes, a better alternative for this CCP would be consolidating functions such as biology under the Service's existing zones or field offices. Sharing these staff resources with many other national wildlife refuges would provide a less expensive and more effective alternative than letting one refuge complex amass and monopolize so many positions.

Response: Refuges typically have various management functions and related programs that require on-site staff. Such management programs cannot simply be relegated to a field office. Our refuges already do and

have been sharing staff resources when and where needed. Consolidation as proposed is a fiscally responsible action given current financial conditions.

Agriculture

A commenter noted that throughout the LPP there is mention that agriculture is a threat to the habitat and wildlife of the region……so it seems reasonable to assume that given the opportunity the Service would severely impede future agricultural operations or even eliminate productive agriculture on a significant amount of acreage in the Plan area.

Response: As described in the Service's preferred alternative, a key component of the refuge's waterfowl management program. The point being made is a generic one regarding the impacts of some agricultural practices in the Chesapeake Bay Region which have been attributed to the over nutrification and hypoxic conditions of the Bay. Runoff of known agrichemical contaminants has occurred for several decades, has been the topic of numerous scientific papers and presentations, and is still considered a threat to water quality through out the Chesapeake Bay watershed.

Mosquito Control

One topic that the Dorchester County Council strongly recommended be discussed in further detail is mosquito control and actions the refuge will take to avoid public health problems, ….associated with West Nile virus, encephalitis, and other mosquito borne diseases.

Response: The DEA has been modified to address these issues. Please refer to page 4-43 and 4-58 of this document for our discussion on mosquito control.

Bird Communities

The management of subgoals and objectives of Goal 1 exclude one bird community of great regional significance at Blackwater, brackish marsh birds. We believe the CCP should place greater emphasis on birds of brackish marsh habitats, due to the high conservation value of the bird community breeding in these habitats. From a regional and global bird conservation perspective, brackish marsh is probably the most important habitat in the refuge complex. It is important that the CCP recognize the distinctness and conservation value of the brackish marsh bird community and plan for its long term management. It is our opinion that brackish marsh birds warrant comparable, or greater, degree of emphasis in the CCP as forest-dwelling species (FIDS). Research into the effects of prescribe burning will be an essential element in determining suitable breeding habitat for marsh birds. We consider such research one of the highest bird conservation priorities at Blackwater NWR. Until results of the prescribed fire research are known we recommend modifying fire management at Black water to a less intensive regime. Objective 1.4.2; add short-eared owl to the list of raptors to benefit from marsh management. It is a PIF priority species and regularly winters in marshes at Blackwater and surrounding areas. Goal 1, subgoal 3, describes Common Snipe and Spotted Sandpiper as breeding birds at Blackwater. However, neither species breeds at the refuge or anywhere on the refuge complex.

Response: A new objectives section was added to Goal 1 to capture the significance of the brackish marsh bird community and future management strategies, including the need to adaptively manage fire in marsh ecosystems. Changes to 1.4.2 and the noted species of breeding birds have also been made.

Regulated Shooting Areas

A stakeholder group points out that they have done a lot of work with Eastern Neck NWR in the past and cooperated fully with Blackwater staff on nutria management. They have taken unpopular stands on issues like Regulated Shooting Areas because they feel it is important to protect the migratory bird resource from potential sources of disease and potential hunting over live decoys and bait. Much of this RSA activity occurs immediately adjacent to Blackwater Refuge. This organization also does many other things (i.e. wetlands and habitat restoration) that complement the activities of the USFWS at Blackwater and elsewhere.

Response: The Service shares your concern about Regulated Shooting Areas and its potential impact to the Blackwater Refuge. The State reports that there are 21 non-commercial RSAs and one commercial RSA in Dorchester County, and most are located immediately adjacent to the refuge. Since RSAs are under private ownership, their operation is beyond the jurisdiction and authority of the Service. The State of Maryland issues annual permits and is otherwise responsible for the management and enforcement of these areas. We greatly appreciate the support that CWH has given the Refuge in the past, and look forward to enhancing and continuing our working partnership on land protection and habitat restoration into the future.

Invasive species

Some commenters believe that some of the introduced species (exotics) are having a detrimental impact, notably the mute swan and the nutria, both of which we see as highly destructive to refuge habitats. The plain fact is that we cannot build habitat as fast as it can be destroyed if nothing is done about these intrusive species and we hope that a maximum effort will be made in this direction. In addition, the nutria eradication effort and marsh restoration will help maintain a marsh buffer to protect the forest habitat from storms and salt water intrusion. Controlling other invasive species in the future may make a critical difference in the quality of the DFS habitat. The increased fire management efforts will provide timber stand improvements needed to enhance the quality of DFS habitat.

Response: An aggressive control and eradication program is planned for exotic, invasive and injurious species management including the mute swan, gypsy moth, purple loosestrife, phragmites, Johnson grass, Canadian thistle, resident Canada geese, and nutria. We have had success reducing the number of nutria on the refuge, which has had a noticeably positive impact on marshlands on the refuge.

Appendix B. Land Protection Plan

USFWS

Aerial view of Blackwater NWR marshes

ANRS
026238

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 Westgate Center Drive
Hadley, MA 01035-9589

In Reply Refer To:
FWS/Region 5/NWRS

JUN 13 2006

Memorandum

To: Director

From: Regional Director, Region 5

Subject: Chesapeake Marshlands National Wildlife Refuge Complex Land Protection Proposal

Thank you for the opportunity to meet with you and others on May 24, 2006, on the Land Protection Proposal (LPP) to expand the acquisition boundary of Blackwater National Wildlife Refuge (NWR), including the addition of a new Nanticoke Division. This LPP has been considered within the context of the draft Comprehensive Conservation Plan (CCP) for Chesapeake Marshlands NWR Complex, which has been reviewed by the public. We received positive comments from the public on the proposal.

As Refuge Manager Glenn Carowan highlighted during his presentation, land protection efforts at the complex are a priority for Region 5, and we are prepared to dedicate necessary resources to this effort within prescribed budgets. For over 14 years, the U.S. Fish and Wildlife Service has been a part of a large and diverse partnership planning effort leading up to the proposed LPP. We are convinced these expansions will significantly contribute to strategic growth of the National Wildlife Refuge System, while also fulfilling our intentions with partners to jointly conserve important habitats on the Delmarva peninsula. The Maryland forest industry is encouraged that we aim to protect habitats from development and, when appropriate, we will work with that industry for needed silvicultural operations to meet habitat objectives. Conservation and management activities on these new lands are expected to contribute significantly to the recovery of the Delmarva fox squirrel.

We are prepared to modify land protection activities identified in the LPP to assure that the Service assumes a highly cooperative and collaborative approach, namely, to not use fee-title in the proposed Nanticoke Division, but emphasize conservation agreements, memoranda of agreement, management agreements, and the like. For the Blackwater NWR area, we believe the use of fee-title is an appropriate and useful tool, although we certainly will use non-fee-title alternatives where appropriate.

We plan to take full advantage of any and all available funding sources to implement the LPP, and not rely solely on Land and Water Conservation Funds. North American Wetlands Conservation Act grants have been used at the refuge before, which are ideally suited for partnership efforts of this type, as are Migratory Bird Conservation Funds. We will also be able to take advantage of land donations.

The CCP for Chesapeake Marshlands NWR Complex is due to be completed this summer to help meet the 2012 deadline for all CCPs. We would very much appreciate your approval of the LPP. If you have any questions regarding this matter, please contact Anthony D. Léger, Regional Chief, National Wildlife Refuge System, at 413–253–8550.

Marvin E. Moriarty

Approved: A Dale Hall Date: 7/19/06

Not Approved: _____ Date: _____

I. Introduction and Purpose

The U.S. Fish and Wildlife Service prepares its land protection plans to inform the public about Service proposals to protect land, and how that may affect them; provide opportunities for public input and, more specifically, for landowners' comments, if they desire; and, confirm for landowners our interest in protecting their lands by various methods. The National Environmental Policy Act (NEPA) gives all interested parties the opportunity to express their viewpoints and concerns about proposed federal actions. Our planning process provides comment periods for landowners, local officials, and the public to suggest other alternatives or additional lands for protection.

This land protection plan (LPP) outlines our actions to meet the habitat objectives of our management goals, objectives, and strategies in the Chesapeake Marshlands National Wildlife Refuge Complex (Complex) draft Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA). Our LPP addresses two areas: the Blackwater refuge and the Nanticoke River corridor. Figure B.1, "Current and proposed protected areas," below, outlines the Blackwater refuge protection areas in red and the Nanticoke River protection areas in orange. We also identify our acquisition and land protection priorities and the boundaries for both areas in relation to other state and private conservation lands. This LPP will guide our future actions in protecting the wildlife resources and ecological integrity of the Blackwater National Wildlife Refuge (NWR) and its proposed expansion eastward along the Nanticoke River.

This LPP does not diminish the rights of any landowner; nor does it constitute an offer to purchase land or any interest in land. The Service is only one agency among state natural resource agencies and private partners in a comprehensive, coordinated protection strategy. All of the partners can work within their own policies, procedures, and time frames for protecting habitat. That approach also gives landowners their choice among the methods for protecting their lands and the agencies with which to negotiate. Any Service fee title purchase will be subject to normal constraints, such as the type and availability of funds and the willingness of landowners to negotiate with us. We will provide landowners with copies of this plan to inform them about Service policies, priorities, and the protection methods we are considering. We will revise the final CCP and this LPP periodically, based first on the public comments we receive and later, on our evaluations of our progress in achieving their goals, but no less often than once every 15 years.

II. Project Area Description

The State of Maryland Governor's Initiative to aid the cleanup and protection of Chesapeake Bay defines the Blackwater and Nanticoke watersheds as priority areas. The Blackwater/Fishing Bay/Nanticoke wetland complex is the largest in the state, and possibly, the largest contiguous assemblage in the Chesapeake Bay. It provides habitat crucial for the survival of more than 270 rare, threatened, or endangered species. Twenty-five of those are considered globally rare. Sixty-eight percent of the wetland habitat types now being protected are decreasing.
The refuge complex comprises these refuges and their divisions in Dorchester, Somerset, and Hartford counties, Maryland, and Accomack County, Virginia: the Blackwater refuge, Susquehanna refuge, Martin refuge, and the Barren Island, Watts Island, and Bishops Head divisions, including Spring Island. This LPP focuses on land in the study areas of the preliminary project proposals for the boundary expansion of the refuge and its eastward expansion to include the Nanticoke River study area approved by our Director in July 1995.

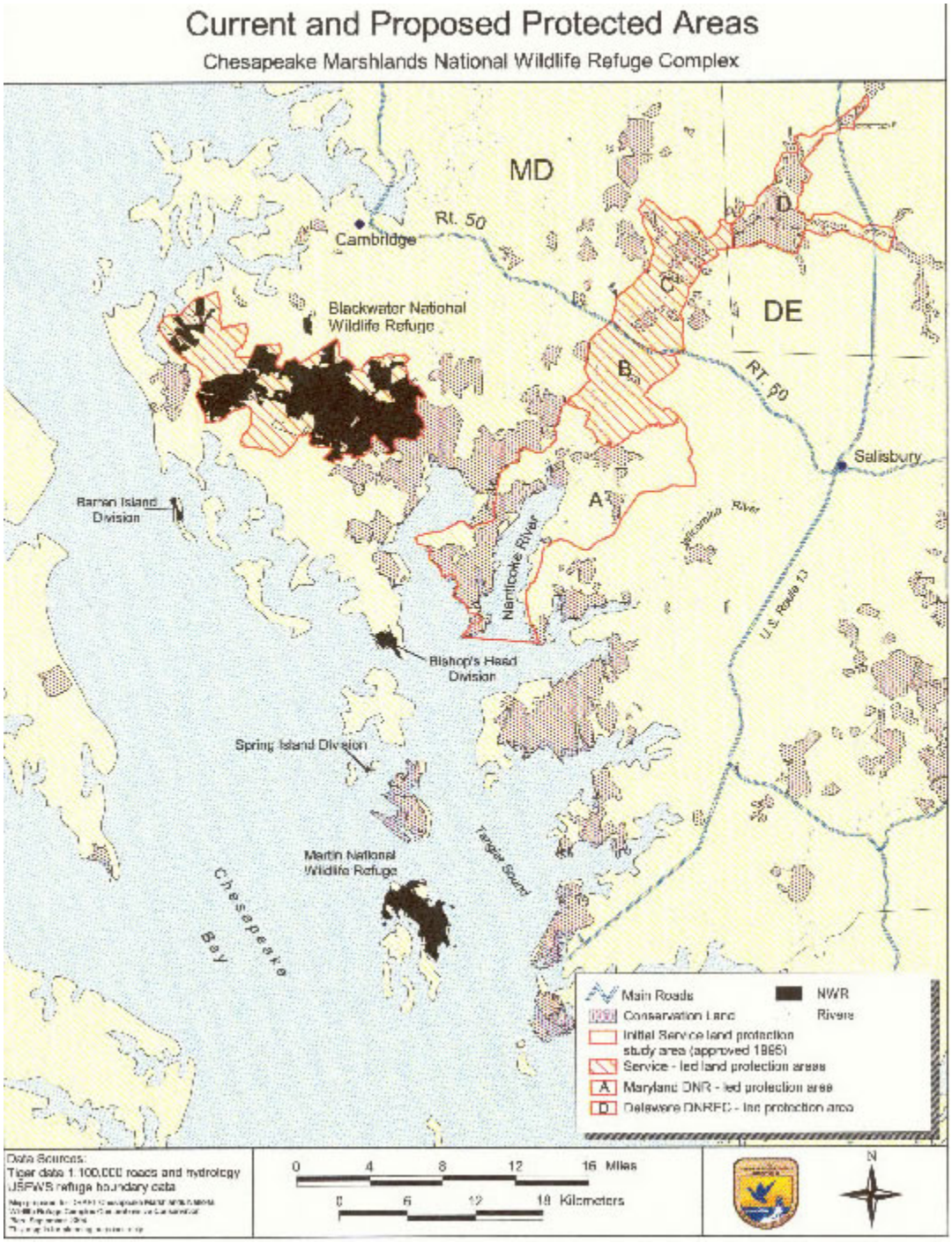


Figure B.1. Current and proposed protected areas

Blackwater NWR is strategically located in southern Dorchester County, Maryland. Originally authorized for establishment as a waterfowl sanctuary by the Migratory Bird Conversation Commission on December 3, 1931, the Blackwater refuge was not officially established until January 23, 1933, when we acquired 8,240.99 acres in fee title from the Delmarvia Fur Farms and two other properties. The refuge is important primarily as migrating and wintering habitat for waterfowl, and is also one of the bay's most productive estuarine assets, supporting diverse aquatic and emergent plant communities. Those plant communities provide critical habitat for small fish, crabs and young seed oysters.

In 1993, the RAMSAR Convention designated the Blackwater refuge a "Wetlands Complex of International Importance" for waterfowl. It consists primarily of brackish marsh and forested swamp, both declining wetland types. Tidal and non-tidal freshwater wetlands and upland islands are other habitat types. Today, the approved boundary of the refuge encompasses 29,389 acres. Twenty inholdings [parcels that remain unacquired within its existing, approved boundary (see figure B.2)], total 3,864.75 acres. We will pursue their protection by all the strategies available in section VII, "Land Protection and Acquisition Methods."

More recently, the refuge became very important in the recovery of federal-listed threatened bald eagle and endangered Delmarva fox squirrel. Its forest, dominated by loblolly pine and deciduous stands, supports the nation's largest naturally occurring concentration of the squirrels, and provides unique habitat for a variety of migratory birds, including Neotropical species. We also regularly demonstrate for the public many refuge activities for resolving problems in the bay ecosystem because of the quality of refuge programs and facilities, the abundance and diversity of its wildlife populations and habitat types, and its proximity to Washington, D.C. and Baltimore, MD.

The refuge also provides important habitat for one or more life cycles of eight anadromous fish species and nine estuarine interjurisdictional species. Federal trust species include the shortnose sturgeon, Atlantic sturgeon, American shad, hickory shad, Atlantic croaker, Atlantic menhaden, alewife, striped bass, American eel, and blueback herring. The populations of five of those species are decreasing. Refuge waters also provide the most important soft crab and peeler crab production area in Chesapeake Bay and the second most significant nursery for blue crab larvae.

The proposed Nanticoke River watershed expansion area is located in Dorchester, Caroline, and Wicomico Counties, Maryland. The area was originally approved as a new refuge in July 1994, but later was revised, complexed with Blackwater, and subsequently approved in 1995.

One of the last relatively pristine, major watersheds on Maryland's lower southwestern Eastern Shore, the Nanticoke River watershed comprises low-lying marshlands, wooded swamps, floodplain forests, loblolly pines and floodplain agricultural fields. The whole project area contains 96,000 acres of tidal and nontidal marshes, wooded swamps, and a third of all of Maryland's tidal wetlands. It is the least developed segment of a major river valley in the state, and harbors the largest unbroken pine forest on the Delmarva peninsula.

The Nanticoke River is an "ERES" or Exceptional Recreational and Ecological Resource. It serves as a major spawning and nursery habitat for striped bass and other important anadromous fish species, including alewives and blueback herring. Because of its undeveloped nature, it is listed on the Nationwide Rivers Inventory. It provides an essential wintering area for black and canvasback ducks. Its habitat types also support active bald eagle nesting sites, and are suitable for the recovery of the Delmarva fox squirrel population. Recognized for its biological diversity, this expansion area includes the largest concentration of nesting bald eagles north of Florida on the Atlantic Coast.

Protecting land along the Nanticoke River would contribute to the resource conservation of a variety of international, national, and regional initiatives, including RAMSAR, IBA, NAWMP and the "National Wetlands Priority Conservation Plan." That river is listed in our "Emergency Wetlands Resources Act Regional Concept Plan" (USFWS), and is a landscape project supported by The Chesapeake Bay Estuary Program. Protecting that land also supports the objectives of the "Management Plan for Canada Geese in Maryland" and the "Chesapeake Bay Waterfowl Policy and Management Plan," and complements the Chesapeake Bay Foundation Save The Bay's Lands Program. Our proposal area is located in both the Delaware and Maryland portions of the Atlantic Joint Venture Area.

The Nature Conservancy has designated the land in the river protection area as a Bioreserve and a "Last Great Place." They developed the "Nanticoke River Bioreserve Strategic Plan" (1998), which outlines the biological significance of the watershed and its threats. More than 23 Natural Heritage Sites lie within the project. Protecting and improving habitat on the Eastern Shore are also critical steps in the North

American Waterfowl Management Plan, which specifically recommends the protection of 53,500 acres and the improvement of an additional 5,000 acres in the Blackwater—Nanticoke protection area.

III. Refuge Land Acquisition Program and Policies

The Service follows a long-standing policy of working with private landowners, using a wide variety of land protection strategies that include conservation easements and management agreements. We negotiate only with willing sellers. Our inclusion of any privately owned land within an approved land protection boundary does not mean that its owner must sell to the Service. Privately owned land remains in the control of its owner. Our boundary identifies important resource areas of interest to the Service, is based primarily on the biological value of an area and its wildlife habitats rather than on land ownership patterns, and gives us the acquisition approval necessary before we can negotiate with any willing sellers.

Once our CCP and LPP have gone through the NEPA public review process and have been approved, we will ask all of the landowners in the approved protection boundary whether they are interested in selling their land. If they are, then a professional real estate appraiser will appraise their properties to determine the market value. Federal law requires us to offer fair market value for land, based on its highest and best legal use. We review each appraisal to ensure that the price it offers accurately reflects the selling prices of comparable properties in the vicinity.

Conservation easements and cooperative management agreements will also be available, if landowners so choose. We strive to minimize or eliminate any adverse impacts on landowners. Therefore, we also pay for title search, mortgage pre-payment penalties, mortgage releases, boundary surveys, deed recordings, relocation and moving costs, if applicable, and other expenses incidental to the transfer of title.

Concepts for the Refuge Land Acquisition Program

The Service establishes new national wildlife refuges and expands existing refuge boundaries to fulfill the mission of the National Wildlife Refuge System and the purposes of the refuges in that system. We acquire land only when other means of achieving program goals and objectives, such as zoning or regulation, are not appropriate, available, or effective. We also acquire the minimum interest necessary to reach management objectives. Alternatives to fee title (full) ownership by the Service include conservation easements, leases, and life-use reservations. If fee title purchase is required, we will fully consider extended use reservations, exchanges, or other alternatives that will lessen any impact on willing sellers or their communities.

Land Acquisition Authority

We cannot purchase any land unless a federal law authorizes such a purchase. These laws authorize us to buy land.

The Migratory Bird Conservation Act of 1929, as amended, "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

The Migratory Bird Hunting and Conservation Stamp Tax of 1934, as amended,"as Waterfowl Production Areas" subject to "all the provisions of such Act (Migratory Bird Conservation Act) ...except the inviolate sanctuary provisions..."

The Fish and Wildlife Coordination Act of 1934, as amended,"shall be administered by him (Secretary of the Interior), directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon,"

The Fish and Wildlife Act of 1956, as amended,(1). "... for the development, advancement, management, conservation, and protection of fish and wildlife resources...," (2). "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude, if such terms are deemed by the Secretary to be in accordance with law and compatible with the purpose for which acceptance is sought."

Refuge Recreation Act of 1962, as amended, for one or more of the following the purposes: "(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species"…." the Secretary …may accept and use…donations of…real…property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors…."

Wilderness Act of 1964, as amended, the purpose of the acquisition is: "wilderness areas…shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness…."

Endangered Species Act of 1973, as amended, "to conserve (A) fish or wildlife which are listed as endangered species or threatened species…or (B) plants…."

Emergency Wetlands Resources Act of 1986, "the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions…."

North American Wetlands Conservation Act of 1989, (1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distributions of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries.

An Act Authorizing the Transfer of Certain Real Property for Wildlife, or Other Purposes, as amended. Land also may be acquired for its "particular value in carrying out the national migratory bird management program."

Funding for Land Acquisition

Funds for the acquisition of national wildlife refuge land or interests in land derive primarily from the Land and Water Conservation Act and the Migratory Bird Conservation Act. Funding for the Migratory Bird Conservation Act comes primarily from the sale of Federal Duck Stamps. The Land and Water Conservation Act funds are composed of certain user fees, proceeds from the disposal of surplus federal property, the federal tax on motorboat fuel, and oil and gas lease revenues. About 80 percent to 90 percent of that fund now derives from Outer Continental Shelf oil and gas leases. The North American Wetlands Conservation Act also authorizes appropriations, and earmarks proceeds from certain migratory bird hunting violation fines and accrued interest from Pittman—Robertson Act funds to implement the North American Waterfowl Management Plan. Those are all dedicated funds whose dollars Congress mandates specifically for wetland and land acquisition and conservation.

IV. Threats to the Resource

In February 2003, the Chesapeake Bay Program Scientific and Technical Committee released its report "Chesapeake Futures: Choices for the 21st Century." Among its key findings, it states "the Bay watershed is on a trajectory to lose two million acres of farm and forest land to sprawl development by 2030." Sprawl is known to produce several times the amount of polluted runoff of forests, pastures, or even cluster developments.

Habitat alteration and destruction are among the imminent major threats for the Blackwater refuge and the Eastern Shore in general. Maryland has lost approximately 1.2 million acres of its historic wetlands: a 73-percent loss. The loss of coastal and estuarine wetlands adversely affects both wildlife and human populations. The destruction and degradation of forest by clearing land for agricultural use, the subsequent commercial and residential development or urban sprawl, the intrusion of salt water, and the runoff of herbicides, pesticides, and fertilizers pose increasing threats for watersheds and their wildlife resources. Other major problems are the loss of marsh and submerged aquatic vegetation to a combination of sea level rise, land subsidence, and erosion caused by nutria. Salt water intrusion into the Upper Blackwater River has become so acute that anadromous fish species and some freshwater fish species cannot spawn successfully.

The major threats to the Nanticoke River watershed are the draining of wetlands and the cutting of timber to convert land to agriculture. The silt and chemical runoff from farming and timbering operations can also heavily impact the water quality of the river. The continued loss of the already limited forest and wetland habitats on the Eastern Shore restrict the management effectiveness of the refuge complex and the long-term ecological health of the Chesapeake Bay as well. To counter those habitat losses, protection of habitats suitable for maintaining and enhancing the recovery of wildlife species populations and biodiversity is necessary. Land protection efforts will also help ensure the long-term protection of the water quality and ecological integrity of their watersheds.

V. Proposed Action

Our approved CCP and LPP will provide the opportunity to protect 31,314 acres by the most appropriate of the methods in section VII, "Land Protection and Acquisition Methods." Although we can manage land within refuge boundaries quite well, we cannot control the degree of threat to the refuge or the habitat resource outside our approved refuge boundary.

We have revised the LPP to include only protection measures other than fee-title acquisition for the Nanticoke Division of Blackwater NWR. The use of easements and management agreements, for example,

is authorized for this division. Fee-title acquisition is authorized only for the boundary expansion contiguous to the existing Blackwater NWR.

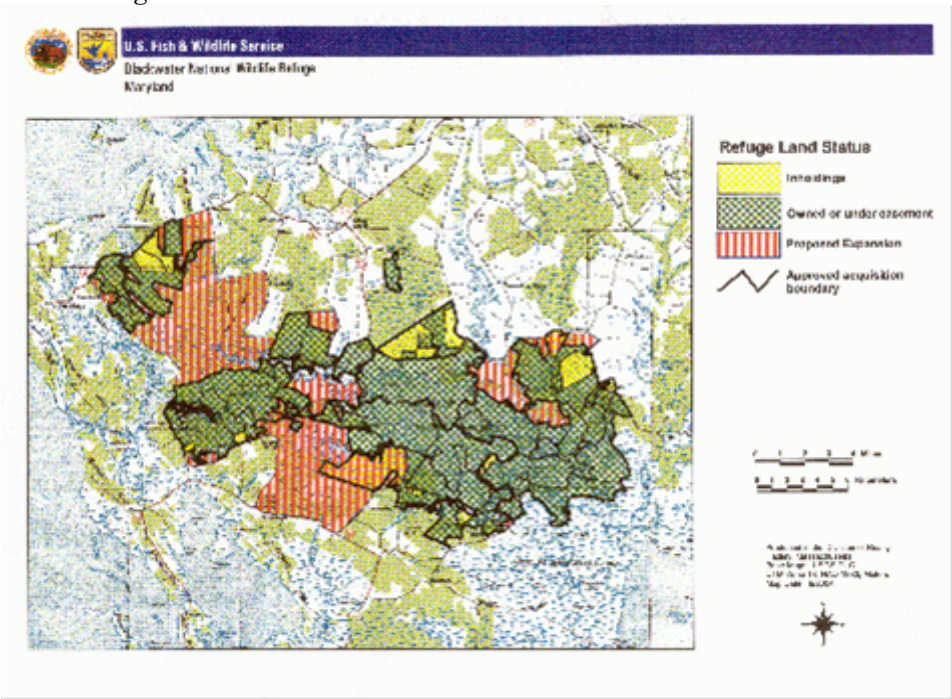


Figure B.2. 1995 proposed expansion boundary

Normally we establish national wildlife refuges in areas of natural resources unique to the Service mission, collectively referred to as federal trust resources. Some examples are threatened or endangered species habitat, migratory bird habitat, nationally significant fisheries, or critically endangered and threatened ecosystems such as submerged aquatic vegetation or coastal marshland in the Chesapeake Bay.

When we have identified such an area, we define a focus area within which land can be transferred to us by fee title purchase, conservation easement, management agreement, or donation. Once land becomes part of a refuge, the refuge manager first posts it, and then develops a management plan to maintain and enhance its resource functions and values. That includes making the area more attractive to wildlife and determining appropriate, compatible, wildlife-dependent public uses.

Land protection is our principal strategy in achieving refuge complex management objectives for endangered and threatened species, migratory birds, Neotropical songbirds, and biodiversity. Our primary goal is to create the most complete network of protected land in the Chesapeake Bay watershed.

In the process of developing land protection strategies in our CCP and this LPP, we identified several specific goals and objectives that will require additional Service land protection: goals that not only will protect Service public trust resources, but also will accomplish the refuge complex recovery tasks and other national or regional goals and objectives. Thus, the Service will seek opportunities to conserve, manage, and protect land through a combination of acquiring land; easements; forging partnerships with adjoining landowners and land trusts; and, developing agreements with other entities having title or other land rights and interests in targeted areas of the watersheds. Twenty inholdings (parcels within the refuge boundary but not yet acquired) at Blackwater refuge total approximately 1,475 acres (see figure B.2, “1995 Approved Acquisition Boundary,” below).

In July 1995, the Director approved a preliminary project proposal (PPP) enabling the refuge to study the likelihood of protecting an additional 17,500 acres at Blackwater refuge. Figure B. 2 shows that study area in vertical red lines. We have already acquired 2,186 of those acres by categorical exclusion. We will pursue

the protection of all the remaining inholdings, and prioritize the acquisition of forest land in or near the core areas that provide optimal breeding habitat for forest birds. We will continue our strategic land acquisition to reduce the patchiness of the existing forest and increase total forest acreage. We will continue to identify key land in the protection areas that will produce the largest strategic gains toward achieving our management goals and objectives outlined below.

Refuge management objectives that require additional land protection include

- providing sufficient habitat necessary to support breeding populations of 12 globally rare and regionally significant migratory birds;
- providing sufficient forest habitat necessary to delist the Delmarva fox squirrel and bald eagle;
- protecting and restoring regionally significant submerged aquatic vegetation (SAV) habitats;
- protecting and restoring the largest colonial and wading bird rookeries in the Bay; and
- implementing the recovery of globally rare and endangered species and habitat

The refuge complex, encompassing more than a third of the bay's tidal marshland in Maryland, plays a critical role in supporting the regionally renowned Chesapeake Bay Watershed partnership and protecting the diversity of living resources that the Chesapeake 2000 Agreement was developed to protect. In a regional context, the refuge complex, the bay's living resources, and the importance of protecting its entire natural system are interconnected. Thus, we coordinate management actions on the refuge complex with achieving the following goals of that agreement throughout the region.

1. Restoring, enhancing, and protecting the finfish, shellfish, and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem;
2. Preserving, protecting, and restoring those habitats and natural areas vital to the survival and diversity of the living resources of the Bay and its rivers;
3. Achieving and maintaining water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health;
4. Developing, promoting, and achieving sound land use practices which protect and restore watershed resources and water quality, maintain reduced pollutant loading for the Bay and its tributaries, and restore and preserve aquatic living resources; and
5. Promoting individual stewardship and assisting individuals, community based organizations, local government and schools to undertake initiatives to achieve the goals and commitments of the agreement.

The proposed eastern Nanticoke River expansion area encompasses approximately 16,000 acres. Our original focus area encompassed 96,000 acres. However, during many years of scoping meetings with our state and NGO partners, we divided the Nanticoke River protection area into the four separate sections or zones shown below in figure B.3, "Nanticoke River Land Conservation Focus Area."

State of Delaware is assigned the upper reaches or section D, and the State of Maryland section A in the lower reaches of the river adjacent to the Fishing Bay Wildlife Management Area. The Service, The Nature Conservancy, and The Conservation Fund will concentrate on two major protection areas, B and C, located north and south of U.S. Route 50 (see figure B.3).

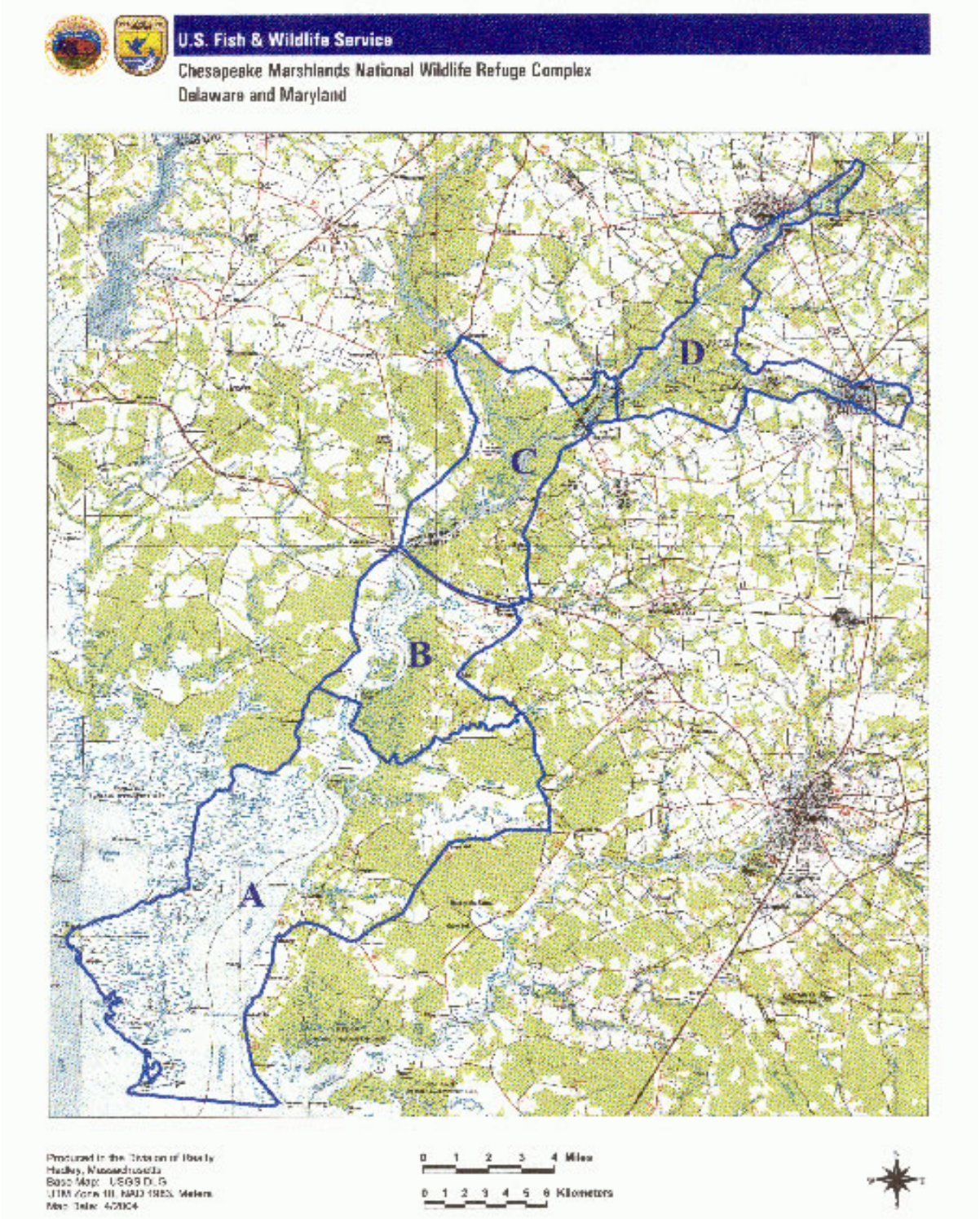


Figure B. 3. Nanticoke River boundary (areas B & C)

Those two areas encompass 32,000 acres of upland and wetland habitat. We will use easements, and memorandums of understanding to protect that important land. We will not use fee title acquisition in the Nanticoke expansion area.

This LPP, in addition to enhancing refuge management objectives, will further develop landscape linkages among Service land and state wildlife management areas. Several smaller, disjunct units of conservation

land also located in the vicinity of the refuge are managed by the state or private conservation organizations, e.g., the Chesapeake Bay Foundation, Audubon, or the Maryland Environmental Trust Program. Thus, the potential for additional landscape linkages and partnerships is very high.

VI. Protection Options Considered

The draft CCP/EA evaluated protection options for these three management alternatives.

Alternative A. No Action or Current Management

Alternative A would not involve the Service in new expansion at the Nanticoke River or the Blackwater refuge. The present refuge boundary would remain unchanged. We would pursue opportunities as they arise to acquire the 1,475 acres of inholdings within that boundary from willing sellers. Land around the refuge would remain in private ownership, and remain subject to development. Those opportunities to restore or enhance habitat would be lost or restricted. We would not plan any concerted expansion of our land protection, although some easements or donations from state agencies or not-for-profit conservation organizations would still be possible.

Alternative B. Conservation Biology for Trust Species Diversity (Preferred Alternative)

Alternative B would enable the Service to pursue the protection of the land immediately surrounding the Blackwater refuge: the 17,500 acres approved in our 1995 PPP, of which we have already acquired 2,186 acres by categorical exclusion. We will continue to identify key land within the protection area that would produce the largest strategic gains toward achieving the management goals and objectives in the draft CCP. We would prioritize the acquisition of forest land in or near the forest cores that provide optimal breeding habitat for forest birds, and acquire inholdings from willing sellers as opportunities arise. We would start to protect the 16,000 acres described in the approved PPP for the Nanticoke River watershed, and continue to assist our partners in developing a landscape protection plan for the region.

Alternative C. Maximum Public Use with No Habitat Management

The primary objective in alternative C is to protect the 31,314 acres identified in alternative B and approved for consideration as an expansion area in the 1995 PPP. We would continue to assist partners in developing a landscape protection plan and the "Delmarva Conservation Corridor Plan," participate in implementing the "Chesapeake 2000 Agreement," and work with local, state and regional government acquisition and easement initiatives on strategic partnerships to coordinate and maximize land acquisition and protection.

Acquisition and Management by Others

Our land protection would depend on the land acquisition and management interests and capabilities of other state resource agencies and non-governmental conservation organizations: e.g., the Trust for Public Land, Audubon, The Nature Conservancy, The Conservation Fund, Eastern Shore Conservation Trust, and Chesapeake Bay Foundation. However, private organizations generally have limited interest or capabilities in owning and managing land on a long-term basis. Nevertheless, they assist the Service and other agencies at times by acting as interim owners, holding the land until government acquisition funding has been approved. The Maryland Agricultural Lands Preservation Foundation and the State Heritage Program protect farmland and ecologically significant areas, respectively. However, agricultural easements do not provide permanent protection unless that land is placed in an agricultural district. In 2001, the Chesapeake Bay Foundation announced a Nanticoke watershed initiative for working with communities along the river to restore degraded wetlands and riparian buffers and conduct education and outreach to promote environmental awareness and support for project assistance.

VII. Land Protection and Acquisition Methods

The Secretary of the Interior is authorized to acquire full or partial interests in land by direct purchase, donation, exchange, cooperative agreement or permit, lease, or transfer. The same methods are also available to private, non-governmental conservation organizations. Those methods provide the land conservation organizations and the landowners the flexibility needed to maximize conservation benefits. A brief description of each method follows.

Purchase, or Fee-title or Fee-Simple Acquisition

Our policy is to acquire land only when other such means as zoning or regulation for achieving program goals and objectives are not appropriate, available, or effective. When we acquire land, the minimum interest necessary to reach management objectives is to be acquired or retained. If fee title purchase is required, we give full consideration to extended use reservations, exchanges, or other alternatives that will lessen any impact on the owner and the community. Donations of desired lands or interests will be encouraged [cf. 341 FW 1].

Conservation Easements

This method allows land to remain in private ownership while the Service controls its management. An easement is voluntary: the landowner retains the deed, less some specific rights. To meet the refuge goal of providing long-term protection for biological resources, any conservation easement the Service acquires must (1) preclude the destruction or degradation of habitat, and (2) allow the Service to adequately manage the use of the land. Usually, that means the purchase of development rights of the property in perpetuity. Easement transactions are recorded in the deed.

We will use conservation easements when they are cost-effective, or when owners do not wish to sell in fee title. The purchase of development rights generally costs 70 percent to 80 percent of the amount to purchase the land.

Once purchased, an easement is a legal restriction on the use of a property, and is binding even if its ownership changes. For that reason, conservation easements generally decrease the value of land and decrease tax revenue. Under the Tax Deductions for Conservation Easements Act [26 U.S.C. 170; Section 6 of P.L. 96–541 (1980)], a taxpayer may take a deduction for contributing a "qualified real property interest" to a charitable organization exclusively for conservation purposes protected in perpetuity. IRS regulations define the value of an easement as the difference between the market value of the land as it is and the market value of the land as encumbered by the specific terms or provisions of an easement. It is not the difference between its worth if developed and its worth if development rights are voluntarily limited.

When the donor retains the mineral interest in the land, in no case may the minerals be extracted by surface mining methods. It should be understood that the acquisition of development rights would meet only some but not all of the purposes for which the refuge was established. Numerous other land uses, such as clear-cutting, applying pesticides, and constructing roads, could still be allowed, but would conflict with many refuge purposes and goals. Some examples of typical restrictions that can be negotiated in conservation easements follow.

Development Rights.—Both commercial and residential development rights, all types of surface disturbance, including sand and gravel mining, the construction of buildings or roads, pipelines, power lines, or other infrastructure.

Disturbance of Vegetation.—Clearing or burning any vegetation, including logging or clear-cutting, or other activities such as grazing, impounding water, applying herbicides or other chemicals, and agricultural operations or other practices that could impact vegetation or wildlife.

Excessive Public Use.—A prohibition on human use and activity at times and in places where they may disturb wildlife or habitat.

Water Quality and Quantity Protection.—The use of water, the placement of wells or impoundments, use of chemicals, or other uses that adversely impact or alter natural water levels, quality or quantity.

Landowner compensation for conservation easements is usually a one-time, up-front payment based on a percentage of the appraised fair market value of the land. It will vary according to the restrictions imposed or rights granted to the Service. Easement properties often are more difficult for the Service to administer than fee-title properties because of their additional monitoring, coordination, and administrative requirements. The Maryland DNR and Farmland Preservation Program have used agricultural and conservation easements.

Donation

A citizen or private organization may donate land or an interest in land to the Service for conservation purposes. Aside from the cost factor, these acquisitions are no different than purchases. Donated land would be appraised for tax purposes. The owner is entitled to a tax deduction based on the appraised value of that property.

Exchange

The exchange of public land for private land is authorized by the Federal Land Policy and Management Act, the Fish and Wildlife Act, and the National Wildlife Refuge System Administration Act. The first allows for the withdrawal of land from the public domain. Inherent in the exchange concept is the requirement to get dollar value for dollar value. Exchanges are attractive because they usually do not require funds for purchase or increase federal land holdings. However, completing those transactions can be very labor intensive and time consuming.

Transfer

The Federal Property and Administrative Services Act authorizes the transfer of excess real property from other federal agencies to the Department of Interior and into the Refuge System. The Transfer of Certain Real Property for Wildlife Conservation Purposes Act (16 U.S. C. 667b-667d)—The Act of May 19, 1948, as amended, provides that, upon a determination by the Administrator of the General Services Administration, real property no longer needed by a federal agency can be transferred without reimbursement to the Secretary of the Interior if the land has particular value for migratory birds, or to a state agency for other wildlife conservation purposes. Many recent military base closures have transferred excess land into the Refuge System. For example, the U.S. Coast Guard has transferred excess land to the Service for inclusion within several of our national wildlife refuges.

Cooperative Agreement or Permit

Sometimes, the Service will enter into a Memorandum of Understanding or cooperative management agreement that allows us the right to manage the land according to the principles of wildlife management. Certain permitted rights allow the Service to carry out its functions and responsibilities regarding the protection of our nation's wildlife resources.

Lease

A written instrument whereby the possession of land and/or an improvement is given by its owner to another person or agency for a specific period (usually 5 to 10 years), according to specific conditions, and for a specific rent. The rights revert to the owner at the termination of the lease. The property remains on the tax rolls during the term of the lease.

This method does not offer permanent, long-term protection, and is generally not cost-effective, because of its limitations on use and the amounts of funding available. For that reason, we dismissed this option from further consideration. However, we can promote and facilitate habitat restoration programs offered by the Natural Resources Conservation Service, the Farm Services Administration, and our own Partners for Wildlife Program within our project area. The refuge will assist interested landowners with such programs as the Conservation Reserve Program and Wetland Reserve Program, which provide funding, materials and technical assistance to restore permanent riparian buffers and other vegetated habitats.

The Service does not have to purchase specific tracts within a rigid time frame. We purchase land from willing sellers as funds become available. However, we can accept donations of land or easements at any time.

VIII. Coordination

We developed this proposal in cooperation with the Maryland DNR, Delaware Department of Natural Resources and Environmental Control, The Nature Conservancy, The Conservation Fund, Chesapeake Bay Foundation, and local and regional land trusts.

On July 14, 1994, refuge staff and the Maryland Department of Natural Resources co-hosted the first long-range partnership planning meeting to begin defining the role of the Service as a partner with others in protecting natural resources in the Blackwater River and Nanticoke River watersheds.

On July 25, 1995, we received approval from our Washington Office to begin detailed planning to protect federal trust resources within those watersheds, including the Chesapeake Island Refuges, and to establish what we then called the "Nanticoke River Unit" of the Blackwater refuge, now the Nanticoke protection area. That approval launched one of the most extensive collaborations ever among the Service, refuge partners, and the public in the Northeast Region to identify and protect valuable ecosystem resources.

On March 14, 1996, the first meeting of watershed partners convened at Blackwater refuge. The participants included representatives from The Nature Conservancy, The Conservation Fund, the Maryland Department of Natural Resources, the Eastern Shore Land Conservancy, the Lower Shore Land Trust, and our Land Acquisition Biologist, Chief of Realty, and Geographic Assistant Regional Director. Subsequently, seven additional intra- and interagency meetings in 1996 and 1997 identified trust resources in the watershed and defined the future role of the Service and the Refuge System in their protection. The signing into law of the National Wildlife Refuge System Improvement Act on October 9, 1997, ushered in a new phase of that refuge planning: comprehensive conservation plans (CCPs). In April and May 1998, additional public input obtained at 20 public scoping meetings and open houses helped guide our refuge management planning process.

The refuge complex programs enjoy tremendous popular and political support. Partnerships have developed in many ways, in every arena of refuge management, including land conservation. Our partnership opportunities now encompass 44 agencies and organizations, providing exceptional opportunities to connect land acquired in the Nanticoke River protection area with existing public holdings. This LPP complements the commitment of the Chesapeake Bay Commission (2001) to "permanently preserve from development 20 percent of the land in the watershed by 2010."

IX. Socioeconomic and Cultural Impacts

We expect no significant adverse socioeconomic or cultural impacts from our proposed land protection and acquisition. Those counties and towns will benefit from increased refuge revenue sharing payments, increased property values, increased watershed protection, increased revenues for local businesses from refuge staff and visitors, savings on the cost of community services, and the maintenance of scenic values, open space, rural character and sense of place.

Blackwater refuge is the largest tourist attraction in Dorchester County, generating a reported $15 million annually from ecotourism. Its attraction is based on the abundance of waterfowl, eagles, and other waterbirds and wildlife that tourists can readily observe, study, or photograph. Very few places provide the same opportunity as our Wildlife Drive for enjoying those priority public uses. Other, less obvious sociological benefits, such as the aesthetic benefits of watching a flock of 20,000 waterfowl against a setting sun over the bay, arise from knowing that places are still available where wild creatures can remain wild and free with their life needs properly satisfied.

We will continue to promote the six priority, wildlife-dependent, recreational uses of the Refuge System, including hunting, fishing, wildlife observation and photography, and environmental education and interpretation, where they are compatible with the management purposes of each refuge. The refuge now has a deer hunting program, wildlife trail system, wildlife observation sites, and an environmental education program and stations. The visitor center at Blackwater NWR is undergoing significant expansion, and a new visitor contact station is proposed for Route 50 near the Nanticoke River. Opportunities for appropriate public access and wildlife-dependent uses will expand to our newly acquired land.

The natural resources of the Chesapeake Bay and waters around and within the refuge complex contribute substantially to the economic health of the State of Maryland and the Nation. Protecting, restoring and enhancing those habitats will provide opportunities to support, maintain or even restore over the long term the economic vitality of the region and the quality of life for residents and visitors alike. Land and water conservation will also provide for the continuation of the cultural heritage of Maryland's watermen by generating an estimated $275 million in direct expenditures for recreational fishing and $1 billion in expenditures and 18,000 jobs related to Chesapeake Bay boating.

The Dorchester County Department of Tourism estimates that Blackwater refuge visitors annually spend $15 million in the county, and have a tremendous impact on local restaurants, hotels, retail merchants and other businesses. About 10 percent of all Dorchester County residents derive their income from jobs related to natural resources that are affected directly or indirectly by the refuge. Both Dorchester and Wicomico counties will realize additional economic benefits from the additional public use outlined in the final CCP. The present and future staffing and operational budget of the refuge complex will contribute significantly to the local economy in the purchase of goods and services.

Land protection, particularly by the purchase of fee title or conservation easements, is unlikely to adversely affect land values in the county or the region. The demand for residential living, employment, or retirement opportunities in the region will continue with or without the additional acreage enrolled in the land protection strategy our plan envisions. When we draw project boundaries, we avoid structures, which we rarely purchase. Therefore, most of a community's real property value remains on its tax rolls after we have completed our land acquisition.

The refuge complex contributes to the economy of its neighboring counties by keeping land in permanent open space. Numerous studies throughout the continental United States have documented that benefit. The benefits of open space have also been documented in "Cost of Community Services Study (COCS)" for Northampton County, Virginia (Adams, et al. 1999) and in a similar, more recent study by the American Farmland Trust, "Cost of Community Services: Making the Case for Conservation" (2002), which analyzes 15 years of COCS studies around the country. Those involve 20 states from New England to Washington

State, and include Carroll, Cecil, and Frederick counties, Maryland. A COCS is a case study analysis of the net fiscal impacts of different land uses. The studies are based on real budgets for specific communities. Their analysis shows what services private residents receive in return for the local taxes they pay.

Those studies repeatedly have shown that open space costs towns less than residential or commercial development, because such development requires certain town services, including schools, utilities, police and fire, emergency services, and solid waste removal. Although residential and commercial development increases the tax base, the expenses the town incurs in providing increased services far outweigh the taxes that development generates. That scenario generally leads to significant property tax increases, which subsequently place an additional tax burden on low- and fixed-income households. Federally owned land demands few services, only minimal road care, and makes an attractive neighbor.

The reduction in developable land may cause the values of similar properties outside the protection areas to increase marginally, as a relatively smaller supply of vacant land will have to satisfy the same level of demand. However, any change will be gradual, because our land acquisition is based on willing sellers and uncertain annual funding appropriations. Other elements of our land protection strategy will provide economic and regulatory incentives to landowners interested in retaining the conservation value of their land, or retaining it in a wildlife-compatible economic enterprise. Some landowners may wish to parcel areas of their land where conservation programs apply and omit other areas; that is their prerogative. We expect that to represent only a small percentage of the land available in the protection areas.

Therefore, we do not expect property values to change significantly inside the protection area. Any land the Service acquires in fee ownership would be removed from the local tax rolls.

To offset that fiscal impact, the Refuge Revenue Sharing Act of 1935, as amended in 1978, provides for payments to offset the loss of tax revenues. Refuge revenue sharing payments for the counties compare favorably with or exceed current tax rates. Each county's payment is based on one of the following formulas, whichever is greatest: 75 cents per acre; three-quarters of 1 percent of the fair market value, or 25 percent of the net receipts collected from the land we own in fee title in that county. Congress may appropriate the funds necessary to offset the difference between the net receipts available and the amount due to the units of local government. The amount of payments on land now classified for agricultural and timber could range from 40 percent to 60 percent higher than the actual taxes now assessed. We reappraise land subject to refuge revenue sharing every 5 years, to keep current its fair market value.

Refuge revenue sharing does not apply to less-than-fee acquisition or conservation easements. However, conservation easements offer their own tax advantages: (a) they reduce estate taxes (reducing the value of the land by selling or donating development rights automatically cuts estate taxes); (b) they obtain current income tax deductions for at least a portion of the value of the gift; and (c) their lower land value results in lower annual real estate or property taxes. To secure a current income tax deduction, an easement gift must be for conservation purposes, and the land has to have some significant conservation qualities. A conservation easement is usually deductible up to a maximum of 30 percent of a taxpayer's adjusted gross income. Any conservation easement must preclude the destruction or degradation of habitat and allow refuge staff to adequately manage the uses of the area to benefit wildlife.

Cumulative, long-term benefits that would result from Service land protection include the

- Maintenance of the rural character of the region and sense of place
- Contributions to the local and regional economy from expenditures relating to the operation and management of the refuge complex and from expenditures by refuge visitor for goods and services in the local area.
- Contributions to the protection of the Chesapeake Bay ecosystems and watersheds of the

Nanticoke and Blackwater Rivers

- Maintenance of wetland functions such as food production, recharge areas and flood protection
- Protection of endangered, threatened and rare species, especially the American bald eagle and the Delmarva fox squirrel
- Protection of waterfowl species, waterbirds, and other species of special concern that depend on these wetlands

Refuge land protection would increase the protection of cultural resources in the area. The owners of land under private ownership in the protection areas are responsible for protecting and preserving its cultural resources. Residential and commercial development may destroy archeological artifacts, historical data, and research opportunities. Research investigations on private land may be discontinued at any time at the discretion of its owner. Conversely, our land protection and acquisition strategy will enhance cultural and historic resources by providing direct protection and management. Cultural sites within refuge boundaries would be protected against vandalism. Our environmental education and interpretation programs will continue to promote public understanding and appreciation of the area's rich cultural resources, and we will conduct appropriate surveys on tracts that need them. Alternative B proposes several initiatives, including the development of an ambitious, refuge-wide inventory and monitoring plan, the implementation of several surveys following national and regional protocols, the development of GIS, and the development and funding of several research endeavors.

The National Historic Preservation Act of 1966 (P.L. 89–665) requires that the State Historic Preservation Officer (SHPO) review any actions by a federal agency that may impact archaeological or historic resources, and that any impacts identified be avoided or mitigated. Service policy is to preserve those resources in the public trust, avoiding impacts whenever possible.

The Archaeological Resources Protection Act of 1979 (P.L.96–95; 16 USC 470aa-mm), provides a strict application and permitting process for scientists who wish to conduct archaeological research on federal property, and mandates severe criminal and civil penalties for vandalism or the unauthorized collection of material from sites on federal lands or waters.

Socioeconomic Impacts

Eastern Shore communities have enjoyed a long-standing relationship with their forests. Initially, they exploited forests as sources of building materials and fuel, and the expanding agricultural economy hastened the clearing of forests until the mid-1800s. Forest acreage stabilized at that low point and the trend slowly reversed, steadily gaining acreage until the turn of the 20th century. The Great Depression set in motion a rapid increase in forested acreage that lasted until the agricultural boom of the mid-1960s, which reduced some previous gains. That trend eventually subsided, and forest acreage has remained relatively stable for the past few decades. Today, the Lower Shore is covered with 5 percent more forest than in 1900.

During those periods of change, the wise use of the forests steadily improved, and an entire industry soon evolved around that resource. Forest science improved with time, and the professional forester emerged as a champion of sustainable management. With a sustainable resource serving demands for timber, the manufacture of forest products became a specialized profession, and indeed, a way of life that was passed on to succeeding generations. From the very beginning of settlement, these forests have remained an integral part of the Eastern Shore economy and culture.

Today, the forest industry employs an estimated 14,000 persons statewide; approximately 5,000 jobs rely directly on the wood harvested in Maryland. More than 8 percent of all manufacturing jobs in Maryland are found in the forest industry. Its output values statewide are $2 billion annually, and contribute more than

$750 million in value-added business income, property income, and taxes. The forest industry is highly integrated, generating economic activity from the growth and management of forests, timber harvesting, paper and lumber production, and the secondary manufacture of final goods. The Port of Baltimore claims to handle the greatest tonnage of forest products of any East Coast port.

Altering the production and supply of forest products will profoundly affect the economy. Every 10-percent decline in output value of the industry would result in a loss of nearly 1,400 jobs and more than $76 million of value-added contributions statewide. If subjected to that 10-percent decline, the Eastern Shore would lose an estimated 143 jobs and more than $6.2 million of value-added contributions. Its forest industry supports more than 2,000 jobs, and each forest industry job creates about one more elsewhere in the economy. In many Eastern Shore counties, forest products manufacture is considered a "basic industry," which by definition produces goods and services that are exported out of the area and bring new dollars into the community. One such county is Wicomico. The sectors of logging, forest management, and primary processing of forest products provide employment for more than 1,100 people on the Eastern Shore.

Dorchester County is one of the leading employers in Maryland's manufacturing sector. The forest products industry supports 8.5 percent of those manufacturing jobs. The average annual wage for the estimated 177 forest products workers in Dorchester County is a robust $58,000, which compares most favorably with the overall manufacturing average wage of $33,000. In Wicomico County, 7.6 percent of its manufacturing base works in the forest products sector (659 employees), earning an average wage of $27,000 (compared to an average manufacturing wage of $35,000). Dorchester and Wicomico counties have a significant number of logging companies and primary wood processing facilities. Although manufacturing on the whole is in decline, the forest products sector remains relatively stable, which speaks to the fact that the forest products industry is growing in importance for the retention of manufacturing employment.

The proposed expansion of the refuge complex in this plan will very likely result in curtailing the supply of forest products. Reducing the availability of timber will impact not just the mills and loggers in Dorchester and Wicomico counties, but will also be felt by the industry across the whole region. The Eastern Shore is effectively an island, bounded on the west and south by the Chesapeake Bay, on the east by the ocean, and on the north by a highly urbanized area. The industry cannot outsource its raw material needs beyond those geographic boundaries of the peninsula. As timber is removed from the supply base, the industry will necessarily increase harvesting pressure on the base remaining. As local supplies draw down, the mills most affected will expand their procurement into the territory of competing mills, thus perpetuating an escalating demand on the mature forests that remain. As local supplies dwindle, the mills will seek timber from greater and greater distances on the peninsula, hauling costs will increase, administrative costs will rise, and the risks of buying timber will increase. Ultimately, weaker mills will be forced to close. That process is already underway, as our CCP points out (page 4–41).

The real danger in that scenario is failing to see the damage caused by incremental losses. A relatively small loss from the timber supply likely will not force the immediate closure of an entire mill, but it will create an unseen, incipient stress that will gradually erode the infrastructure. Once the supply, support, and intellect of the industry have left an area, they are extremely difficult to recreate.

That fact is well understood by the State of Maryland. The overriding management philosophy for the recently acquired Chesapeake Forest Lands is to provide the needed commodity values (i.e., timber) from those lands, sustainably, without sacrificing the non-commodity values also derived (e.g., habitat or recreation). In 2004, Governor Ehrlich signed Executive Order 01.01.2004.21 at a ceremony on the Eastern Shore to replicate that approach on all DNR-owned forest land. To further accentuate its commitment to the sustainability of the resource, the state is aggressively pursuing third-party environmental certification on its forests from both of the leading international certifying bodies. The private sector is also moving gradually toward certification, in some cases building on its participation in the existing Tree Farm Program.

That commitment to sustainable forest management is much more comprehensive than simply preserving economies and cultures for future generations. It sustains the infrastructure that provides the management services. Without those services, which depend on adequate markets, we have a toolbox with no tools. We need the service providers supported by the forest industry to perform the work necessary for managing the forests over the long term. If the Blackwater Game Refuge plans to harvest timber as part of its proposed plan, it will also need these service providers (Kirk Rogers, pers. comm. July 28, 2005).

As previously mentioned, much of the forested land now part of the refuge complex once was managed for the production of forest products, supplying them to families and many small, locally owned mills as well as large, regional corporations. Some of the Blackwater refuge land was owned and managed by both large- and small-scale forest product corporations such as Chesapeake Forest Products and Spicer Corporation. They supplied forest products throughout Maryland and many other states. Once that land was protected by the Service, it was taken out of timber production, and no longer provided the forest products that helped keep small, local mills in business. Performing wildlife-oriented forest habitat management on Blackwater refuge would result in the sale of forest products and additional, indirect, increased revenues for the local economy. The sale of the timber would also eliminate the need to use refuge complex staff and funding to implement forest management prescriptions.

Implementing manual methods of release and weed control is also very effective in achieving habitat management objectives, and will create a source of employment that will contribute to the local economy or provide for volunteer opportunities. Many of those objectives also may be achieved through a firewood cutting program we will develop later.

The effects on hydrologic conditions on off-refuge land would be the most significant and sensitive sociological impact of hydrologic restoration related to Atlantic white cedar management on the proposed Nanticoke protection area. Eliminating or restricting drainage ways on the refuge could result in flooding on adjacent agricultural and residential land and tree plantations. We would assess and closely monitor the effects of on-refuge restoration so that off-refuge impacts are eliminated or mitigated. The use of water control structures may be necessary to control water levels and reduce the potential flooding of private properties.

The sociological aspects of forest habitat management programs are complex, and vary widely across geographic boundaries. Although people in rural America appreciate and promote those activities, particularly the cutting of trees, people from urban settings or backgrounds are less likely view them the same way. In many cases, urban Americans see and hear only the negative aspects of forest management, and associate those programs on refuges with the destruction of wildlife and the commercialization of the resource, rather than with the objectives of wildlife habitat and forest health improvement and other environmental benefits.

Despite the immense potential of managing forests for diverse public and equally diverse wildlife populations, pleasing all interest groups and individuals is impossible. Some would object to management in any form, and arguing against the pursuit of natural values would be difficult. Realistically, few areas remain where the protection of the habitat alone is the only necessary management option. That is especially true where man has already caused significant impacts on the landscape, as at Blackwater refuge and the Nanticoke protection area. Most of their habitats are degraded, are far from natural, and suffer a growing inability to support the historical abundance and diversity of fauna that is now necessary and even expected. Environmental education and interpretation programs about the refuge forest management program would address many of those concerns and issues.

We would reduce potential conflicts while educating a more knowledgeable public by providing a well-staffed visitor center on the proposed Nanticoke protection area with the potential to reach more than 6 million visitors a year; publishing a film, interpretation tour guides and informative leaflets about the area; providing proper signing; and printing maps and brochures that convey the mission and goals of the area

and better understanding of its proposed management. We would improve our good association with the community, and help establish a better understanding of the area, its mission, goals, wildlife and wildlife habitats, by developing programs, events, and activities with community organizations, the tourism industry, schools, local businesses, news media, congressional entities, constituent groups, and state and local government agencies.

Public interest has been steadily increasing in observing and photographing wildlife while walking, biking, canoeing, or driving. Along with the increased opportunities for wildlife observation at the Nanticoke protection area, more facilities are provided, better relationships with the community are developed, and more visitors to the area are welcomed. The communities around the area would benefit from the increased use of their service stations, facilities, lodging, and restaurants. If the current $15 million a year in benefits to the local economy is any indication of what can be expected at the proposed area, those activities would significantly increase the potential for ecotourism-related businesses.

Dorchester, Wicomico, and Somerset counties are developing tourism management plans that will increase and facilitate ecotourism. Developing environmental education programs with other educational institutions and groups in the community would create a good working relationship with the community and public, increasing their interest in working with Blackwater refuge to help develop ecotourism. Working with the respective county tourism offices and the community to increase ecotourism would help increase the economy of the local area even more.

Public interest has been steadily increasing in observing wildlife while walking, biking, canoeing, and driving throughout the area. Refuge programs would add some structure and regulation to those activities, which would become more compatible with wildlife and sensitive habitats. For example, after the Blackwater refuge was listed in the Maryland biking travel guides, the number of bicyclists at the refuge increased from 842 in 1992 to 3,275 in 1995. Publications by Dorchester County advertising Blackwater's trails, its Wildlife Drive and visitor center have also attracted more visitors seeking opportunities to observe wildlife at the refuge. According to the Dorchester County Department of Tourism, Blackwater refuge visitors spend an estimated $15 million annually. The refuge is the most utilized tourist attraction in Dorchester County. With the new Dorchester County Tourism Plan and the nearly completed construction of a new Hyatt complex in Cambridge, MD, the county expects to attract many more visitors. The encouragement of bus tours to Dorchester County has already increased the number of bus tours to Blackwater refuge. Increased visitation at these refuges would positively impact the local economy and, if properly planned, would not adversely impact wildlife.

As more people become aware of the boating, fishing, and crabbing opportunities available in Dorchester, Wicomico, and Somerset counties, more people would visit the refuges. Canoeing is becoming a very popular recreation that enables visitors to fish and view wildlife. Many visitors are requesting canoe trail maps, navigational maps, leaflets on fishing and canoeing, canoe tours, rentals, and directions for observing wildlife from canoes. A recent seminar on recreational activities in Dorchester County in preparation for the construction of the Hyatt complex also indicated a need for canoe rentals, canoe tours and guides. That demand has encouraged the establishment of at least one canoe rental company, although previously there were none in the county. In partnership with the State of Maryland and Dorchester County, we would construct a new canoe ramp and associated parking area at Route 335 to accommodate safe parking and launching from the state highway into the upper Blackwater River (waters unregulated by the refuge). Those facilities would encourage more visitors to stay overnight in the county, rent canoes, buy fishing licenses and equipment, dine at restaurants, and shop at other facilities, thus increasing the economy of the county.

With the exception of waterfront property, real estate values for the region dropped during the late 1980s and 1990s. That trend has reversed in the last several years, with an increase in recent economic activity and the desire for second homes on the Eastern Shore. The property values of land with the potential for waterfront residential and commercial development have been increasing between 6 percent and 20 percent

annually. Statewide, the values of agricultural land increased about 10 percent between 1996 and 2000 (Source: Maryland Agricultural Statistics webpage 2000). The value of forest land has also increased moderately, but a troubling statistic is the continuing trend to smaller and smaller ownership patterns (Source: Maryland Forest Service webpage 2000).

Land protection, particularly by acquiring land by purchasing either fee title or conservation easement, is unlikely to adversely affect land values in that county or the region. The demand for residential living and employment or retirement opportunities in the region will continue, with or without the additional acreage enrolled in the land protection strategy we envision.

Caputo (1979) has identified five economic benefits associated with open space preservation (e.g., parks, refuges, recreation areas). First, land adjacent to public parks or natural areas was found to increase in value faster than the respective municipality average. The values and appreciation of residential property immediately adjacent to state or federal wildlife management areas or refuges here in the Northeast generally increase 20 to 30 percent. However, the actual percentage increase will vary from town to town and state to state. A survey of 15 lakes and reservoirs in Pennsylvania evaluated impact on local land values (EPP 1971), and showed that the total taxable land value of an area that develops recreational sites will increase more rapidly over time than comparable taxable land that does not develop recreational resources. The lakes the survey studied range from 160 acres in two state parks to more than 21,000 acres in the Corps of Engineers Kinzua Reservoir. As property values increase, assessments increase, and more property tax revenues are realized.

Some problems in our land protection could arise because of the roll-back of tax exemptions. The counties would have to make formal decisions on a case-by-case basis, guided by state law. However, preliminary inquiries by the Service have indicated that this would not be a problem, as land use would remain essentially the same. Revenue sharing payments for the counties would compare favorably with or exceed current tax revenues.

Because of community concerns about the removal of land from agricultural production, the refuge complex long ago initiated an approach that will maintain existing land uses that conform to a compatibility determination. That policy will extend to most agricultural land in the protection areas (the next paragraph notes exceptions). Likewise, when feasible and appropriate, most prior-converted wetlands will be developed into moist-soil impoundment units or otherwise managed for agricultural production to benefit migrating and wintering waterfowl. Landowners always have the option of maintaining land in wildlife-compatible uses, including certain farming and forestry operations. Implementing our land protection strategy will not significantly affect agricultural production and farm income statewide or on the Eastern Shore.

Open space, farms and wild lands are declining resources in the region and nationwide. Some areas can be kept usable for wildlife and recreation, but the creation of new, wild, open space in the true sense is impossible. Under Service protection, present land-use patterns would undergo little or no change. Some prior-converted wetlands will likely be allowed to revert to palustrine forest to prevent erosion into adjacent riverine and aquatic systems and assist in many of our goals and objectives. Agricultural practices on some land will be modified to provide feeding and sheltering areas for migratory birds, under programs and strategies similar to those already employed on the Blackwater refuge. Protection monies can be used to purchase conservation easements from landowners who are interested in continuing their current use while selling their development rights. Such a program would allow former landowners or tenant farmers to continue raising crops on protected land or parts of it while also providing benefits for wildlife. Also possible are lease-back agreements, which would give the seller or others who rent land an opportunity to continue using it for crop production. Agricultural land could remain in production, thus helping maintain the livelihood of the farmers. The farmers or landowners would have the first refusal option to enter into a lease-back agreement, while the tenant or party renting the land would be given the second option.

Appendix C. Rare Species in the Nanticoke River Watershed

USFWS

Delmarva Fox Squirrel

Species likely to occur on the Refuge Complex, based on Maryland and Delaware Natural Heritage Programs data

Source: "Nanticoke River Bioreserve Strategic Plan" (The Nature Conservancy, 1998)

See "Explanation of Global and State Species Ranks" following this table. "Federal status" from USFWS.

Table C.1. Rare Species in the Nanticoke River Watershed

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS					
Rhynchospora microcephalia	Tiny-headed beak-rush	G?		S1/(S2)	Open Canopy Herbaceous Wetlands
**Agalinis acuta*	Sandplain gerardia	G1	LE	S1	*No records; may have occurred here historically*
Oxypolis canbyi	Canby's dropworth	G1G2	LE	S1/N	Open Canopy Herbaceous Wetlands
Aeschynomene virginica	Sensitive joint-vetch	G2	LT	N/S2	Atlantic White Cedar Swamps
Lobelia boykinii	Boykin's lobelia	G2		N/S2	Other Natural Communities
Desmodium ochroleucum	Cream-flowered tick-trefoil	G2G3		S1/(SH)	Xeric Dune Communities
Hypericum adpressum	Creeping St. John's wort	G2G3		S1/S1	Xeric Dune Communities
Alnus maritima	Seaside alder	G3		S1/S2	Coastal Plain Ponds
Coreopsis rosea	Rose coreopsis	G3		S2/S4	Open Canopy Herbaceous Wetlands
Eriocaulon parkeri	Parker's pipewort	G3		N/S1S3	Xeric Dune Communities
Gaylussacia brachycera	Box huckleberry	G3		S1/N	Open Canopy Herbaceous Wetlands
Helonias bullata	Swamp pink	G3	LT	S2	
Rhexia aristosa	Awned meadow-beauty	G3		S1/(S1)	Xeric Dune Communities
Rhynchospora harperi	Harper's beak-rush	G3		S3/S1	Open Canopy Herbaceous Wetlands
Sagittaria teres	Slender arrowhead	G3		SH/S1	Open Canopy Herbaceous Wetlands
Rhynchospora pallida	Pale beak-rush	G3?		S2/(SH)	Other Natural Communities
Agalinis virgata	Pine-barren gerardia	G3G4		S3/S2	Freshwater Intertidal Wetlands & Atlantic White Cedar Swamps
Bidens mitis	Small-fruited beggarticks	G3G4		S2/S2	Open Canopy Herbaceous Wetlands
Carex mitchelliana	Mitchell's sedge	G3G4		S1/N	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Litsea aestivalis	Poundspice	G3G4		S2/S4	Open Canopy Herbaceous Wetlands
Scirpus etuberculatus	Canby's bulrush	G3G4		(S2)/SH	Xeric Dune Communities

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Rhynchospora inundata	Drowned horned-rush	G3-G4		N/S1	Other Natural Communities
Cardamine longii	Long's bittercress	G3G4Q		SH/S2	Open Canopy Herbaceous Wetlands
Erianthus brevibarbus	Short-beard plumegrass	G3G5		N/S1	Coastal Plain Ponds
Lobelia elongata	Elongated lobelia	G3G5		S1/S3	Open Canopy Herbaceous Wetlands
Pycnanthemum setosum	Awned mountain-mint	G3G5		SH/SH	Xeric Dune Communities
Amphicarpum purshi	Buel maiden-cane	G4		(S1)/S1	Riverine Wetlands
Carex barrattii	Barratt's sedge	G4		S3/S2	Coastal Plain ponds & Open Canopy Herbaceous Wetlands
Carex collinsii	Collin's sedge	G4		N/S1	Xeric Dune Communities
Carex gigantea	Giant sedge	G4		SH/S2	Freshwater Intertidal Wetlands
Carex venusta	Dark green sedge	G4		S3/S3	Atlantic White Cedar Swamps & Open Canopy Herbaceous Wetlands
Cleistes divaricata	Spreading pogonia	G4		S3/(S1)	Freshwater Intertidal Wetlands
Cyperus histricinus	Flat sedge	G4		S2/S2	Atlantic White Cedar Swamps & Open Canopy Herbaceous Wetlands
Desmodium strictum	Pinkland tick-trefoil	G4		S1/S4	Open Canopy Herbaceous Wetlands
Dichanthelium scabriusculum	Panicgrass	G4		S1/S2	Freshwater Intertidal Wetlands
Dichanthelium wrightianum	Wright's witchgrass	G4		S3/S1	Open Canopy Herbaceous Wetlands
Elatine americana	American waterwort	G4		S1/(SH)	Freshwater Intertidal Wetlands
Eleocharis brittoni	Britton's spike-rush	G4		S3/S4	Freshwater Intertidal Wetlands & Atlantic White Cedar Swamps
Eleocharis equisetoides	Knotted spike-rush	G4		N/S1	Atlantic White Cedar Swamps & Open Canopy Herbaceous Wetlands
Eleocharis melanocarpa	Black-fruited spike-rush	G4		N/S2	Riverine Wetlands
Eleocharis tricostata	Three-angle spike-rush	G4		S2/S1	Open Canopy Herbaceous Wetlands
Fuirena pumila	Smooth fuirena	G4		S2/S2	Freshwater Intertidal Wetlands
Gymnopogon ambiguous	Beardgrass	G4		S3/(S1)	Freshwater Intertidal Wetlands

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Helianthemum propinquum	Low frostweed	G4		S1/(S1)	Open Canopy Herbaceous Wetlands
Isoetes riparia	Riverbank quillwort	G4		S3/S1	Other Natural Communities
Lachnanthes caroliana	Carolina redroot	G4		S3/S4	Open Canopy Herbaceous Wetlands
Listera australis	Southern twayblade	G4		S3/S1	Freshwater Intertidal Wetlands
Lobelia canbyi	Canby's lobelia	G4		S1/N	Freshwater Intidal Wetlands & Coastal Plain Ponds
Lygodium palmatum	Climbing fern	G4		S1/S1	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Platanthera flava	Southern rein-orchid	G4		N/S1	Freshwater Intertidal Wetlands
Rhynchospora nitens	Short-beaked baldrush	G4		S3/S1	Coastal Plain Ponds
Rhynchospora nitens	Short-beaked baldrush	G4		S3/S1	Open Canopy Herbaceous Wetlands
Rhynchospora scirpoides	Long-beaked baldrush	G4		(S3)/S1	Other Natural Communities
Rhynchospora scirpoides	Long-beaked baldrush	G4		N/SH	Open Canopy Herbaceous Wetlands
Rhynchospora torreyana	Torrey's beak-rush	G4		S3/S1	Freshwater Intertidal Wetlands
Sagittaria subulata	Subulate arrowhead	G4		S2/S2	Open Canopy Herbaceous Wetlands
Sagittaria subulata	Subulate arrowhead	G4		S2/N	Freshwater Intertidal Wetlands
Sclerolepis uniflora	Pink bog-button	G4		SH/SX	Other Natural Communities
Utricularia radiata	Small swollen bladderwort	G4		S1/S1	Xeric Dune Communities
Utricularia resupinata	Reversed bladderwort	G4		S2/S2	Open Canopy Herbaceous Wetlands
Vaccinium macrocarpon	Large cranberry	G4		S1/S2	Open Canopy Herbaceous Wetlands
Hypericum gymnanthum	Clasping-leaved St. John's wort	G4?		N/S2	Xeric Dune Communities
Lespedeza stuevei	Tall bushclover	G4?		S2/S2	Coastal Plain Ponds
Paspalum dissectum	Walter paspalum	G4?		N/S2	Xeric Dune Communities
Triadenum walteri	Walter's St. John's wort	G4?		S1/S4	Atlantic White Cedar Swamps
Agalinis setacea	Thread-leaved gerardia	G4G5		S2/S1	Coastal Plain Ponds

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Aristida virgata	Wand-like three-awn	G4G5		S1/S1	Open Canopy Herbaceous Wetlands
Asclepias rubra	Red milkweed	G4G5		(S2)/S2	Coastal Plain Ponds
Carex joorii	Cyprus swamp sedge	G4G5		(S1)/S2	Open Canopy Herbaceous Wetlands
Carex styloflexa	Bent sedge	G4G5		(S1)/S1	Other Natural Communities
Ceratophyllum muricatum	Prickly hornwort	G4G5		S1/SH	Coastal Plain ponds
Desmodium obtusum	Stiff tick-trefoil	G4G5		S2/S2	Atlantic White Cedar Swamps
Eleocharis robbinsii	Robbin's spike-rush	G4G5		S3/(SH)	Other Natural Communities
Fraxinus profunda	Pumpkin ash	G4G5		N/S1	Xeric Dune Communities
Fuirena squarosa	Hairy umbrella sedge	G4G5		N/SH	Open Canopy Herbaceous Wetlands
Gratiola ramosa	Branching hedgehyssop	G4G5		(S1)/S1	Other Natural Communities
Iris prismatica	Slender blue flag	G4G5		S1/S2	Open Canopy Herbaceous Wetlands
Juncus elliottii	Bog rush	G4G5		(S1)/S2	Open Canopy Herbaceous Wetlands
Juncus militaris	Bayonet rush	G4G5		S1/SH	Xeric Dune Communities
Lobelia glandulosa	Glandular lobelia	G4G5		N/S1	Open Canopy Herbaceous Wetlands
Scirpus subterminalis	Water clubrush	G4G5		S1/S2	Open Canopy Herbaceous Wetlands
Smilax pseudochina	Long-stalk greenbriar	G4G5		SH/S2	Open Canopy Herbaceous Wetlands
Tephrosia spicata	Southern goat's rue	G4G5		N/S1	Riverine Wetlands
Toxicodendron pubescens	Poison oak	G4G5		S1/(S1)	Open Canopy Herbaceous Wetlands
Utricularia fibrosa	Fibrous bladderwort	G4G5		S1/S1	Open Canopy Herbaceous Wetlands
Rhynchospora fusca	Brown beak-rush	G4-G5		S1/N	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Sabatia diffornis	Two-formed pink	G4-G5		S2/S2	Other Natural Communities
Agalinis fasciculata	Fascicled gerardia	G5		S1S2/S1	Xeric Dune Communities
Asclepias lanceolata	Few-flowered milkweed	G5		S1/S1	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Aster spectabilis	Showy aster	G5		S1/S1	Coastal Plain Ponds
Bidens connata	Purple-stem swamp beggarticks	G5		S1/S1	Xeric Dune Communities

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Bidens discoidea	Swamp beggarticks	G5		S1/S1	Open Canopy Herbaceous Wetlands
Boltonia asteroides	Aster-like boltonia	G5		S1/N	Xeric Dune Communities
Bromus latiglumis	Broad-glumed brome	G5		S3/S4	Other natural communities
Campanula aparinoides	Marsh bellflower	G5		S3/N	Open Canopy Herbaceous Wetlands
Carex complanata	Hirsute sedge	G5		N/S1	Xeric Dune Communities
Carex lacustris	Lake-bank sedge	G5		N/S2	Other Natural Communities
Centella erecta	Erect coinleaf	G5		SH/S1	Other Natural Communities
Centrosema virginianum	Coastal butterfly-pea	G5		S1/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Chasmanthyium latifolium	Indian sea-oats	G5		S1/S1	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Cladium mariscoides	Twig rush	G5		S1/S1	Open Canopy Herbaceous Wetlands
Clitora mariana	Maryland butterfly-pea	G5		N/S2	Xeric Dune Communities
Coelorachis rugosa	Wrinkled joint-grass	G5		S3/(S3)	Open Canopy Herbaceous Wetlands
Commelina virginica	Virginia dayflower	G5		S2/S1	Open Canopy Herbaceous Wetlands
Comptonia peregrina	Sweet fern	G5		S1/S3	Open Canopy Herbaceous Wetlands
Cyperus retrofractus	Rough cyperus	G5		N/S2	Xeric Dune Communities
Desmodium glabellum	Dillen tick-trefoil	G5		S1/(S1)	Riverine Wetlands
Desmodium laevigatum	Smooth tick-trefoil	G5		S2/S2	Riverine Wetlands
Drosera rotundifolia	Round-leaf sundew	G5		SH/S1	Open Canopy Herbaceous Wetlands
Elatine minima	Small waterwort	G5		S3S4/S2	Other Natural Communities
Eleocharis acicularis	Least spike-rush	G5		S1/S1	Open Canopy Herbaceous Wetlands & Freshwater Intertidal Wetlands
Eleocharis tortilis	Twisted spike-rush	G5		SU/(SH)	Open Canopy Herbaceous Wetlands
Equisetum hyemale	Rough horsetail	G5		(SH)/S1	Other Natural Communities
Eragrostis hirsuta	A love grass	G5		S1/N	Open Canopy Herbaceous Wetlands
Eragrostis refracta	Meadow love grass	G5		(S1)/S1	Xeric Dune Communities
Erianthus contortus	Bent-awn plumegrass	G5		S1/S1	Open Canopy Herbaceous Wetlands

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Eriocaulon compressum	Flattened pipewort	G5		S2/S1	Open Canopy Herbaceous Wetlands
Eriocaulon decangulare	Ten-angle pipewort	G5		S2/S2	Open Canopy Herbaceous Wetlands
Eriocaulon septangulare	Seven-angle pipewort	G5		S1/S1	Coastal Plain Ponds
Eupatorium album	White boneset	G5		N/S1	Open Canopy Herbaceous Wetlands
Eupatorium leucolepis	White-bracted boneset	G5		S1/S2	Open Canopy Herbaceous Wetlands
Gentiana catesbaei	Catesby's gentian	G5		S1/SH	Open Canopy Herbaceous Wetlands
Glyceria canadensis	Canada manna-grass	G5		S1/S2S3	Freshwater intertidal wetlands & Coastal Plain ponds
Helianthus angustifolius	Swamp sunflower	G5		SH/S1	Freshwater Intertidal Wetlands
Hydrocotyle verticillata var. triradiata	Whorled pennywort	G5		S3/S2	Open Canopy Herbaceous Wetlands
Hypericum boreale	Northern St. John's wort	G5		S1/S1	Xeric Dune Communities
Hypericum densiflorum	Bushy St. John's wort	G5		S1/S1	Open Canopy Herbaceous Wetlands
Hypericum denticulatum	Coppery St. John's wort	G5		S1/S4	Xeric Dune Communities
Juncus coriaceus	Leathery rush	G5		S3/S2	Freshwater Intertidal Wetlands & Riverine Wetlands
Juncus pelocarpus	Brown-fruited rush	G5		S2/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Juncus torreyi	Torrey's rush	G5		S3/S1	Atlantic White Cedar Swamps
Kalmia angustifolia	Sheep laurel	G5		S1/S1	Open Canopy Herbaceous Wetlands
Lechea mucronata	Hairy pinweed	G5		S1/S1	Xeric Dune Communities
Lemna perpusilla	Minute duckweed	G5		S3/S2	Atlantic White Cedar Swamps & Open Canopy Herbaceous Wetlands
Leptoloma cognatum	Mountain hairgrass	G5		N/SH	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Lespedeza angustifolia	Narrow-leaf bushclover	G5		S1/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Ludwigia hirtella	Hairy ludwigia	G5		N/S3	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Lupinus perennis	Wild lupine	G5		S1/S1	Open Canopy Herbaceous Wetlands
Lycopodium dendriodeum	Ground pine	G5		S1/S1	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Lycopodium tristachyum	Deep-root clubmoss	G5		S1S2/S2	Riverine Wetlands
Lycopus amplectens	Sessile-leaved bugleweed	G5		S1/S1	Other Natural Communities
Lysimachia hybrida	Lowland loosestrife	G5		S1/(S1)	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Melanthium virginicum	Virginia bunchflower	G5		S1/SH	Xeric Dune Communities
Myrica heterophylla	Evergreen bayberry	G5		N/S1	Other natural communities
Myriophyllum humile	Low water-milfoil	G5		S3S4/S2	Xeric Dune Communities
Nymphoides aquatica	Larger floating-heart	G5		S1/S1	Open Canopy Herbaceous Wetlands
Oldenlandia uniflora	Clustered bluets	G5		N/S1	Xeric Dune Communities
Panicum oligosanthes	Heller's witchgrass	G5		N/S1	Atlantic White Cedar Swamps & Open Canopy Herbaceous Wetlands
Panicum ravenelii	Ravenel's witchgrass	G5		S3/S1	Xeric Dune Communities
Passiflora incarnata	Purple passion flower	G5		S3/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Platanthera cristata	Crested yellow orchid	G5		S1S2/S4	Xeric Dune Communities
Platanthera lacera	Green-fringed orchid	G5		S2S3/(S4)	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Pogonia ophioglossoides	Rose pogonia	G5		(S3)/S2S3	Other Natural Communities
Polygala cruciata	Cross-leaved milkwort	G5		(S1)/S1	Atlantic White Cedar Swamps & Open Canopy Herbaceous Wetlands
Polygata incarnata	Pink milkwort	G5		(SH)/S1	Open Canopy Herbaceous Wetlands
Polypodium polypodiodes	Resurrection fern	G5		S1/S1	Atlantic white cedar swamps
Quercus lyrata	Overcup oak	G5		S3/S2	Open Canopy Herbaceous Wetlands
Quercus marilandica	Blackjack oak	G5		S2S3/(S1)	Freshwater Intertidal Wetlands
Ranunculus pensylvanicus	Bristly crowoot	G5		S2/(S3S4)	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Rhynchospora alba	Pale beak-rush	G5		S1/S2	Open Canopy Herbaceous Wetlands
Rhynchospora cephalantha	Captate beak-rush	G5		N/SH	Other Natural Communities
Rhynchospora cephalantha	Captate beak-rush	G5		N/S2	Xeric Dune Communities
Rhynchospora globularis	Grass-like beak-rush	G5		S1/S4	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Rhynchospora glomerata	Clustered beak-rush	G5		(S3)/S1	Xeric Dune Communities
Rhynchospora glomerata	Clustered beak-rush	G5		S3/S1	Other Natural Communities
Rhynchospora gracilenta	Slender beak-rush	G5		S1/S2	Coastal Plain Ponds
Rhynchospora gracilenta	Slender beak-rush	G5		S1/S2	Open Canopy Herbaceous Wetlands
Rotala ramosior	Toothcup	G5		(S1)/S2	Other Natural Communities
Sabatia campanulata	Slender marsh pink	G5		S2/S2	Coastal Plain Ponds
Sagittaria calycina	Spongy lophotocarpus	G5		S3/S1	Riverine Wetlands
Sagittaria calycina	Spongy lophotocarpus	G5		SH/SRF	Open Canopy Herbaceous Wetlands
Sarracenia purpurea	Northern pitcher-plant	G5		SH/SH	Other Natural Communities
Sarracenia purpurea	Northern pitcher-plant	G5		S1/S1	Coastal Plain ponds
Scirpus cylindricus	Salt marsh bulrush	G5		S3/S2	Atlantic White Cedar Swamps
Scleria pauciflora	Few-flowered nutrush	G5		S1/S2	Open Canopy Herbaceous Wetlands
Scleria reticularis	Reticulated nutrush	G5		N/S3	Other natural communities
Scleria reticularis	Reticulated nutrush	G5		S3/S1	Open canopy herbaceous wetlands
Scleria triglomerata	Whip nutrush	G5		S3/S4	Open Canopy Herbaceous Wetlands
Scleria triglomerata	Whip nutrush	G5		S1/S1	Open Canopy Herbaceous Wetlands
Smilax walteri	Red-berried greenbriar	G5		SU/S1	Other Natural Communities
Smilax walteri	Red-berried greenbriar	G5		S2/S1	Freshwater Intertidal Wetlands, Atlantic White Cedar Swamps, Open Canopy Herbaceous Wetlands
Solidago speciosa	Showy goldenrod	G5		S1/S1	Open Canopy Herbaceous Wetlands

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Solidago stricta	Wandlike goldenrod	G5		S1/S1	Xeric Dune Communities
Spirodela punctata	Duck-weed	G5		S1/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Symplocus tinctoria	Horse-sugar	G5		S3/S1	Xeric Dune Communities
Taxodium distichum	Bald cypress	G5		S3/S3	Freshwater Intertidal Wetlands
Thelypteris simulata	Bog fern	G5		S1/S4	Freshwater Intertidal Wetlands
Trichosterna setaceum	Narrow-leaved blue curls	G5		S3/(S1)	Freshwater Intertidal Wetlands
Utricularia biflora	Two-flower bladderwort	G5		N/S1	Open Canopy Herbaceous Wetlands
Utricularia gibba	Humped bladderwort	G5		S3/(S1)	Open Canopy Herbaceous Wetlands
Utricularia inflata	Swollen bladderwort	G5		(S3)/S1	Xeric Dune Communities
Utricularia juncea	Southern bladderwort	G5		S2/(S2)	Freshwater Intertidal Wetlands
Utricularia purpurea	Purple bladderwort	G5		S2/S5	Xeric Dune Communities
Utricularia subulata	Zig-zag bladderwort	G5		S1/S1	Open Canopy Herbaceous Wetlands
Xyris fimbriata	Fringed yellow-eyed grass	G5		S2/S2	Freshwater Intertidal Wetlands & Riverine Wetlands
Xyris smalliana	Small's yellow-eyed grass	G5		(SH)/S1	Open Canopy Herbaceous Wetlands
Desmodium viridiflorum	Velvety tick-trefoil	G5?		N/S2	Other Natural Communities
Panicum hemitomun	Maidencane	G5?		N/S2	Xeric Dune Communities
Sagittaria engelmanniana	Engelmann's arrowhead	G5?		S2/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Sagittaria lancifolia	Bull-tongued arrowhead	G5?		N/S2	Freshwater Intertidal Wetlands & Atlantic White Cedar Swamps
Sagittaria lancifolia	Bull-tongued arrowhead	G5?		(S3)/S2	Other Natural Communities
Scirpus smithii	Smith's bullrush	G5?		SH/S2	Open Canopy Herbaceous Wetlands
Panicum columbianum	Hemlock panicgrass	G5Q		SH/S1	Other Natural Communities
Salicornia bigelovii	Dwarf glasswort	G5Q		S1/S2	Coastal Plain Ponds & Open Canopy Herbaceous Wetlands
Chameacrista fasciculata var. macrosperma	Marsh wild senna	G5T2Q		(S1)/S2	Xeric Dune Communities

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
PLANTS CONTINUED					
Panicum commonsianum	Common's panicgrass	G5T4		N/S1	Xeric Dune Communities
Gaylussacia dumosa var. bigeloviana	Huckleberry	G5T4T5		N/S2	Other Natural Communities
Chimaphila umbellata ssp.cisatlantica	Common wintergreen	G5T5		S2/N	Xeric Dune Communities
Commelina erecta var. angustifolia	Slender dayflower	G5T5		SH/(SH)	Other Natural Communities
Melampyrum lineare var. pectinatum	Cow-wheat	G5T5		N/S1	Xeric Dune Communities
Micranthemum micranthemoides	Nuttall's micranthemum	GH		N/S2S3	Other Natural Communities
ANIMALS					
Acantharchus pornotis	Mud sunfish	G5		N/S1	
Acipenser brevirostrum	Shortnose sturgeon	G3	LE	S1	
Acipenser oxyrhynchus	Atlantic sturgeon	G3		S2/S2	
Agkistrodon contortrix	Northern copperhead	G5		S1/N	
Ambystoma tigrinum	Eastern tiger salamander	G5		N/S1	
Ammodranus henslowii	Henslow's sparrow	G4		S2/(S2)	
Anodonta implicata	Alewife floater	G5		S1S2/SHB	
Apeltes quadracus	Fourspine stickleback	G5		N/S1	
Ardea herodias	Great blue heron	G5		N/SH	
Argia bipunctulata	Seepage dancer	G4		N/S2B	
Atrytonopsis hianna	Dusted skipper	G4G5		N/S1	
Bartramia longicauda	Upland sandpiper	G5		N/S1	
Battus philenor	Pipevine swallowtail	G5		S1/SHB	
Boloria selene myrina	Silver-bordered fritillary	G5T5		N/S2	
Botaurus lentiginosus	American bittern	G4		S3/(S1)	
Buteo lineatus	Red-shouldered hawk	G5		S2/(S1B,SZN)	
Caretta caretta	Atlantic loggerhead turtle	G3	LT	S1B	
Cemophora coccinea	Scarlet snake	G5		N/S2B,SZN	
Chelonia mydas	Atlantic green turtle	G3	LT	S1N	
Chordeiles minor	Common nighthawk	G5		S3/SH	

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
ANIMALS CONTINUED					
Cicindela dorsalis dorsalis	Northeastern beach tiger beetle	G4T2	LT	S1	
Circus cyaneus	Northern harrier	G5		S3S4B/S2B	
Cistothorus platensis	Sedge wren	G5		S2/(S1B)	
Clemmys guttata	Spotted turtle	G5		S2/N	
Coccyzus erythopthalmus	Black-billed cuckoo	G5		N/S3	
Cottus bairdi	Mottled sculpin	G5		N/S1B	
Dendroica dominica	Yellow-throated warbler	G5		N/S1	
Dermochelys coriacea	Atlantic leatherback turtle	G3	LE	S1	
Egretta caerulea	Little blue heron	G5		N/S2B	
Elaphe guttata	Corn snake	G5		S2S3/S1B	
Elliptio fisheriana	Northern lance	G4		N/S1	
Enneacanthus chaetodon	Black-banded sunfish	G5		N/S2	
Enneacanthus obesus	Banded sunfish	G5		S1/S1	
Eretmochelys imbricata	Atlantic hawksbill turtle	G3	LE	SRN	
Etheostorna vitreum	Glassy darter	G4		N/S2	
Falco columbarius	Merlin	G4		S1/N	
Falco peregrinus	Peregrine falcon	G3		N/S2N	
Gastrophryne carolinensis	Eastern narrow-mouthed toad	G5		S1/(S1N,SEB)	
Gavia immer	Common loon	G5		S1S2/N	
Gomphaeschna furcillata	Harlequin darner	G5		N/S2N	
Haliaeetus leucocephalus	Bald Eagle	G4	LT	N/S1	
Hemileuca maia	Woodland buck moth	G4		S2S3/S1B	
Hesperia metea	Cobweb skipper	G4G5		N/S3	
Himantopus mexicanus	Black-necked stilt	G5		N/SU	
Hyla chrysoscelis	Cope's gray treefrog	G5		N/S2B	
Incisalia irus	Frosted elfin	G4		N/S2	
Lampetra aepyptera	Least brook lamprey	G5		S1/S1	
Lampropeltis getula	Eastern kingsnake	G5		N/S2	
Lampsilis radiata	Eastern lampmussel	G5		N/S2	
Lanius ludovicianus	Loggerhead shrike	G4		SU/SH	

Scientific name	*Common name*	*Global rank*	*Federal status*	*State rank (MD/DE)*	*Community type*
ANIMALS CONTINUED					
Laterallus jamaicensis	Black rail	G4?		S1/SHB,SHN	
Lepidochelys kempii	Atlantic ridley turtle	G1	LE	S1N	
Melanerpes erythrocephalus	Red-headed woodpecker	G5		S2?/(S1B)	
Mitoura grynea	Olive hairstreak	G5		N/S1B	
Mitoura hesseli	Hessel's hairstreak	G3G4		N/S2	
Moxostoma macrolepidotum	Shorthead redhorse	G5		SH/S1	
Notropis amoenus	Comely shiner	G5		N/S2	
Notropis chalybaeus	Iron-color shiner	G5		N/S2	
Opheodrys aestivus	Rough green snake	G5		N/S2	
Poanes arroni aaroni	Saffron skipper	G4T4		N/S2	
Poanes massasoit	Mulberry wing	G4		N/SU	
Podilymbus podiceps	Pied-billed grebe	G5		N/S1	
Problema bulenta	Rare skipper	G2G3		S2/S2B,S2N	
Pseudotriton montanus	Eastern mud salamander	G5		S1/(S1)	
Rana virgatipes	Carpenter frog	G5		N/S1	
Riparia riparia	Bank swallow	G5		S2/(S1)	
Satyrium kingi	King's hairstreak	G3G4		N/S2B	
Scincella lateralis	Ground skink	G5		S1S2/(S1)	
Sciurus niger cinereus	Delmarva fox squirrel	G5T3	LE	N/S1	
Septophaga ruticilla	American redstart	G5		S1/(S1)	
Sitta carolinensis	White-breasted nuthatch	G5		N/S2B	
Sterna antillarum	Least tern	G4		N/S2B,S5N	
Storeria dekayi	Northern brown snake	G5		S2/(S1B)	
Storeria occipitomaculata	Northern redbelly snake	G5		N/S3	
Strix varia	Barred owl	G5		N/S1	
Virginia valeriae	Smooth earth snake	G5		N/S2	

Explanation of Global and State Species Ranks

Originally developed and instituted by The Nature Conservancy, an international conservation organization, the global and state ranking system is used by all 50 State Natural Heritage Programs and numerous Conservation Data Centers in other countries in this hemisphere. Because they are assigned based upon standard criteria, the ranks can be used to assess the range-wide status of a species as well as the status within portions of the species' range. The primary criterion used to define these ranks are the number of known distinct occurrences with

consideration given to the total number of individuals at each locality. Additional factors considered include the current level of protection, the types and degree of threats, ecological vulnerability, and population trends. Global and state ranks are used in combination to set inventory, protection, and management priorities for species both at the State as well as regional level.

Global Ranks

G1 Highly globally rare. Critically imperiled globally because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Globally rare. Imperiled globally because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or distributed locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; typically with 21 to 100 estimated occurrences.

G4 Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery.

GH No known extant occurrences (i.e., formerly part of the established biota, with the expectation that it may be rediscovered).

GU Possibly in peril range-wide, but its status is uncertain; more information is needed.

GX Believed to be extinct throughout its range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? The species has not yet been ranked.

_Q Species containing a "Q" in the rank indicates that the taxon is of questionable or uncertain taxonomic standing (i.e., some taxonomists regard it as a full species, while others treat it at an infraspecific level).

_T Ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species.

State Ranks

S1 Highly State rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor(s) making it especially vulnerable to extirpation. Species with this rank are actively tracked by the Wildlife and Heritage Division (WHD).

S2 State rare. Imperiled in Maryland because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor(s) making it vulnerable to becoming extirpated. Species with this rank are actively tracked by WHD.

S3 Watch List. Rare to uncommon with the number of occurrences typically in the range of 21 to 100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by WHD.

S3.1 A "Watch List" species that is actively tracked by WHD because of the global significance of Maryland occurrences. For instance, a G3 S3 species is globally rare to uncommon, and although it may not be currently threatened with extirpation in Maryland, its occurrences in Maryland may be critical to the long term security of the species. Therefore, its status in the State is being monitored.

S4 Apparently secure in Maryland with typically more than 100 occurrences in the State or may have fewer occurrences if they contain large numbers of individuals. It is apparently secure under present conditions, although it may be restricted to only a portion of the State.

S5 Demonstrably secure in Maryland under present conditions.

SA Accidental or a vagrant in Maryland.

SE Established, but not native to Maryland; it may be native elsewhere in North America.

SH Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.

SP Potentially occurring in Maryland or likely to have occurred in Maryland (but without persuasive documentation).

SR Reported from Maryland, but without persuasive documentation that would provide a basis for either accepting or rejecting the report (e.g., no voucher specimen exists).

SRF Reported falsely (in error) from Maryland, and the error may persist in the literature.

SU Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State. Uncertainty spans a range of 4 or 5 ranks as defined above.

SX Believed to be extirpated in Maryland with virtually no chance of rediscovery.

S? The species has not yet been ranked.

S ? A question mark after another rank indicates uncertainty regarding that rank.

State Status

This is the status of a species as determined by the Maryland Department of Natural Resources, in accordance with the Nongame and Endangered Species Conservation Act. Definitions for the following categories have been taken from Code of Maryland Regulations (COMAR) 08.03.08.

E Endangered; a species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.

I In Need of Conservation; an animal species whose population is limited or declining in the State such that it may become threatened in the foreseeable future if current trends or conditions persist.

T Threatened; a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

X Endangered Extirpated; a species that was once a viable component of the flora or fauna of the State, but for which no naturally occurring populations are known to exist in the State.

* A qualifier denoting the species is listed in a limited geographic area only.

Federal Status

This is the status of a species as determined by the U.S. Fish and Wildlife Service Office of Endangered Species, in accordance with the Endangered Species Act. Definitions for the following categories have been modified from 50 CFR 17.

LE Taxa listed as endangered; in danger of extinction throughout all or a significant portion of their range.

LT Taxa listed as threatened; likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

PE Taxa proposed to be listed as endangered.

PT Taxa proposed to be listed as threatened.

C Candidate taxa for listing for which the Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

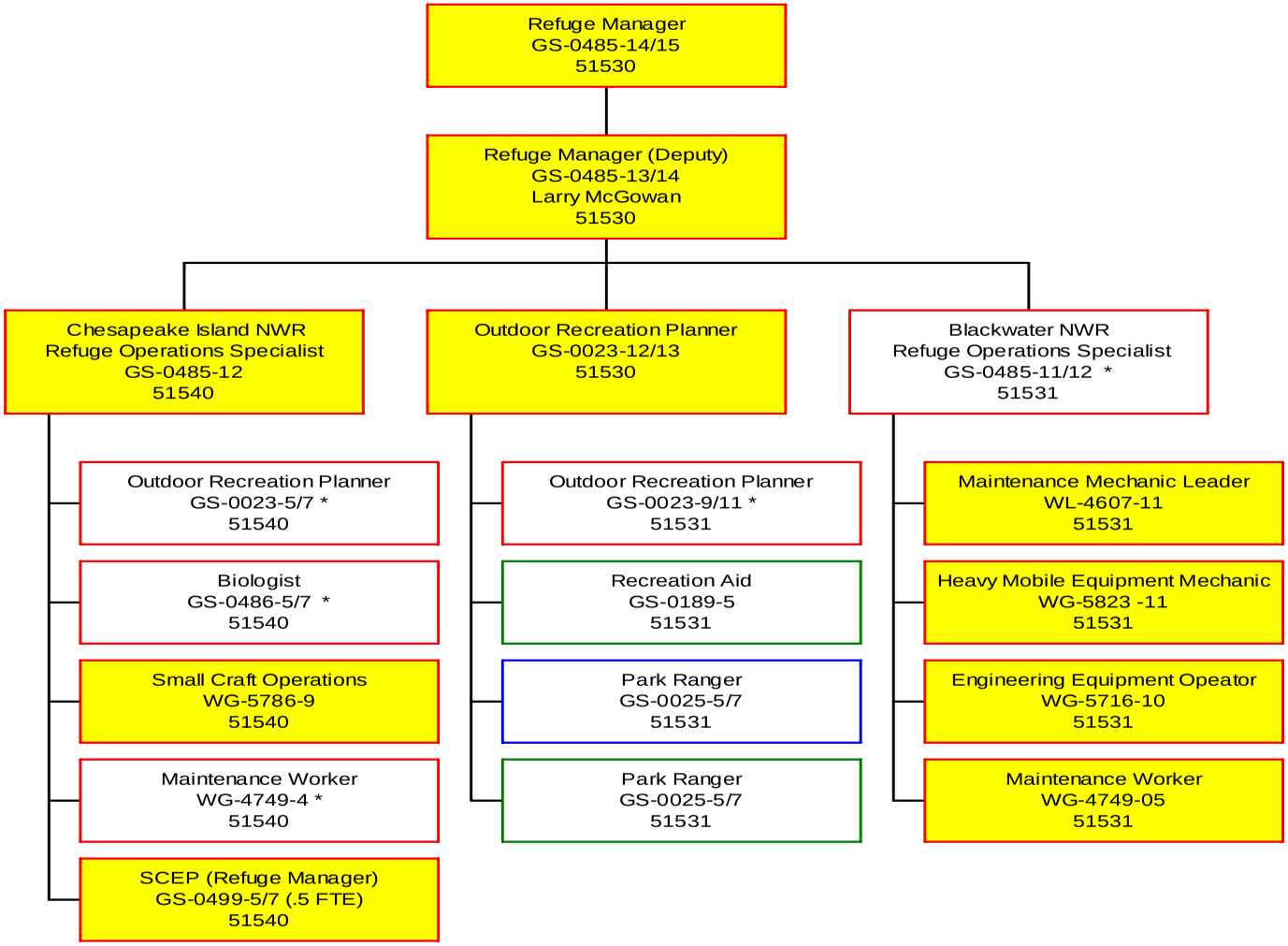
Appendix D. Organization Charts

USFWS

Refuge staff work to control invasive species such as Phragmites australis

U.S. Fish and Wildlife Service
Chesapeake Marshlands National Wildlife Refuge Complex

Existing Staff Chart



ALT A = +

ALT B = + -

ALT C = + + -

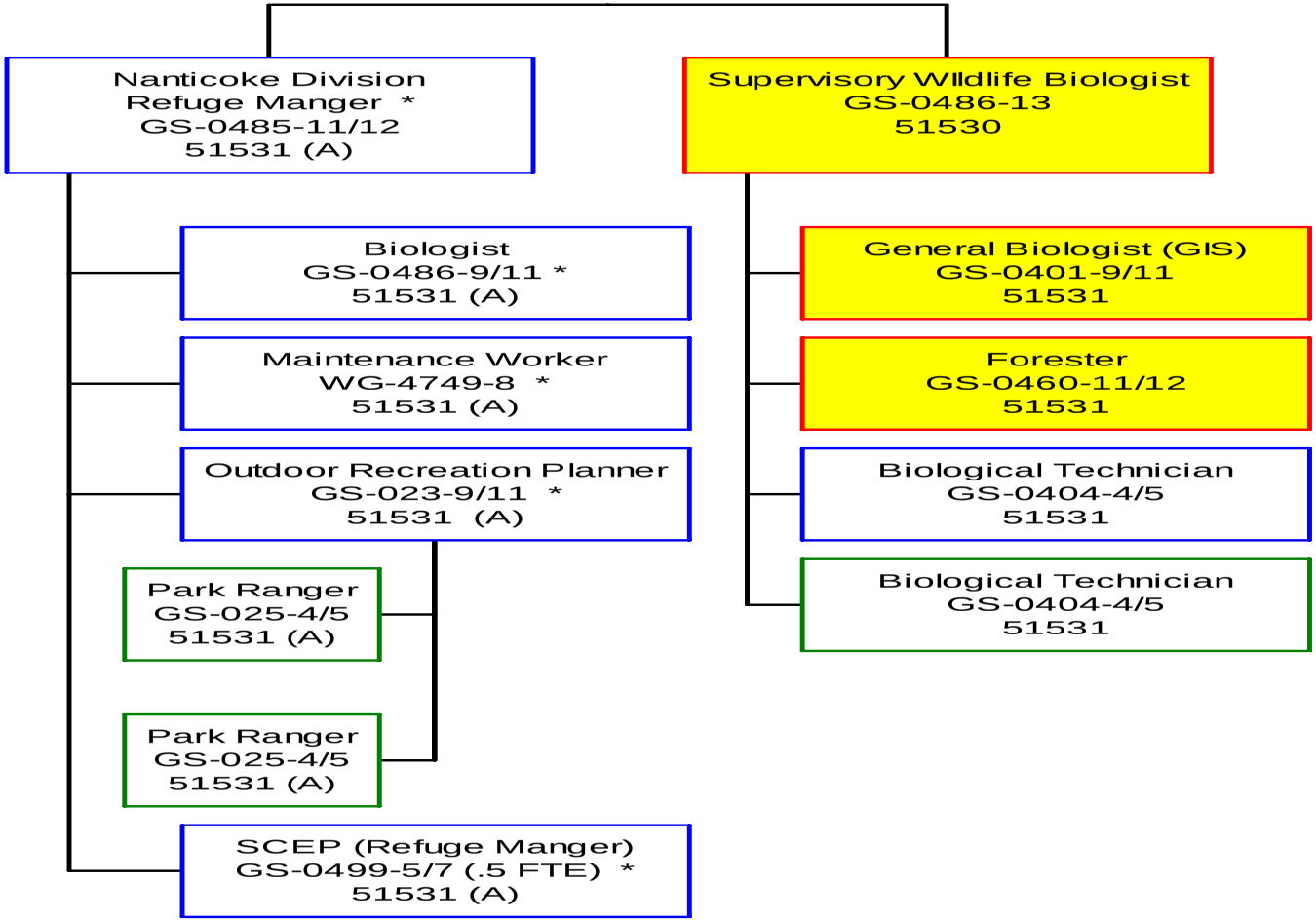
Current =

* = Tier 1Critical mission vacancies

51530 – Complex's Administrative/Supervisory Staff
51531 – Blackwater NWR
51531 (A) – Nanticoke Focus Area
51540 – Chesapeake Island Refuges

U.S. Fish and Wildlife Service
Chesapeake Marshlands National Wildlife Refuge Complex

Updated Staffing Chart Based on CCP Guidance



ALT A = +

ALT B = + +

ALT C = + + +

Current =

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51530 – Complex's Administrative/Supervisory Staff
51531 – Blackwater NWR
51531 (A) – Nanticoke Focus Area
51540 – Chesapeake Island Refuges

Appendix E. Compatibility Determinations

USFWS

Blackwater NWR manages forest to protect Bald eagles, Delmarva fox squirrel, forest interior dwelling species, and other species that depend on upland habitat

COMPATIBILITY DETERMINATION

Use: Cropland Management

Station Name: Blackwater National Wildlife Refuge

Establishing and Acquisition Authorities:

The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of four nationally significant wildlife areas: Blackwater NWR, Martin NWR, Eastern Neck NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Eastern Neck NWR, and Susquehanna NWR, with the respective associated divisions, are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table I summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):

For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."

For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."

For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:

"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of cooperative farming with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is cropland management through a cooperative farming agreement. Cropland management is not a priority use identified by The National Wildlife Refuge System Improvement Act of 1997, but it is an integral and historical management strategy at Blackwater NWR.

Background and Rationale for the Management Activity

The approved CCP states that a priority goal to support the station's primary purpose and Service's mission is to "Protect and enhance Service trust resources and other species and habitats of special concern." The first subgoal of this priority goal is to "provide habitats to sustain 10 percent of each of Maryland's wintering waterfowl populations of Atlantic Population (AP) Canada geese, snow geese, and dabbling ducks." The refuge objectives outlined in the approved CCP for meeting the goal and subgoal include monitoring wintering waterfowl populations, restoring emergent marsh on Blackwater NWR, managing approximately 460 acres of impoundments for moist soil management, and managing approximately 420 acres of croplands on Blackwater NWR.

Due to wetland loss and degradation, natural food resources are inadequate to sustain (and certainly to increase) the current levels of waterfowl use on Blackwater NWR. Furthermore, very few "hot foods" (e.g., corn and sorghum, which are high in carbohydrates and energy) are available off-refuge; those that are, are consumed early in the winter season. When birds have to travel long distances to seek food off the refuge in severe winter weather, their energy reserves are quickly depleted. Consequently, the refuge plants row crops and cool-season grasses or forbs each year, presently as forced-account, to sustain wintering migratory waterfowl during critical periods of nutritional and physical stress. High-protein cover crops of Ladino clover and buckwheat, over-seeded with winter wheat, receive heavy waterfowl use the entire winter. Sorghum and corn provide high carbohydrates during midwinter and periods of extreme weather when food sources generally are unavailable. Japanese millet is planted in low elevation fields and in some MSUs, where early flooding in the autumn is likely. Small acreages also are planted in sunflowers for migrating waterfowl and granivorous passerines (see alternative A for details). Contractual planting of corn and sorghum crops with force account planting of the cool season grasses and forbs is recommended as the preferred option in this alternative, because it minimizes labor and equipment on the part of the refuge

while retaining the most nutritious composition of croplands to meet the seasonal needs of waterfowl. Cooperative farming is proposed as a second option, should funding not be available for contractual planting and force account responsibilities.

(B) Where would the use be conducted?

Approximately 420 acres of existing croplands (2 percent of the refuge's total acreage) would be managed annually to achieve refuge purposes and wildlife management objectives. Figures E.1-E.7 identify fields where cropland management activities will occur. Cooperative farming would occur on up to 115 acres or 27% of the refuge's croplands.

(C) When would the use be conducted?

Cropland management activities normally would begin in mid-May and continue until mid-October, annually.

(D) How would the use be conducted?

The preferred option in our approved CCP would involve contractual planting approximately 100 to 120 acres in corn and milo (sorghum), and approximately 300 acres in cool season grasses and forbs, consisting of ladino or crimson clover, annual rye grass, and winter wheat (over-seeded with buckwheat). A total of 100 percent of the crops would be left unharvested exclusively for wildlife utilization. Lands having Conservation Reserve Program or similar easements would be managed and maintained in accordance with NRCS guidelines and requirements. The planting of the corn and milo would be contracted each year on a competitive bid basis to a local farmer for a fixed price per acre, and would be left unharvested for use by waterfowl and other wildlife. Refuge staff, equipment, and operational dollars would be used to plant and cultivate the cool season grasses and forbs. Crop rotations would occur on a three to one ratio: three years in cool season grasses or forbs, followed by 1 year corn or milo, then back to grasses and forbs for another 3 years. The corn and milo acreage would not be plowed under in the spring, but would be left to succeed to warm season grasses after the annual rye grass, or crimson clover has died with the onset of warm weather. Only in the fall would these lands be cultivated and replanted to winter wheat or buckwheat, which later would be over-seeded back to ladino clover the following February (freezing in the seed rather than planting with normal tillage). The wheat would be allowed to mature in early summer to provide food for passerines and other wildlife.

If sufficient funding for the preferred contractual and force account activities described above were not available, our second option would be to manage the cropland program with a combination of force account activities and cooperative farming. Because of the nature of cooperative farming and the requirement for an economic incentive to obtain or retain cooperating farmers, the cropland management scheme and rotations would be significantly different than the preferred option. Crop composition and acreages would vary annually with a variety of different scenarios possible. In a scenario with 100% cooperative farming, 100 to 120 acres of corn or milo and 300 to 320 acres of soybeans would be planted annually with the refuge's share being the entire corn crop for wildlife use. The cooperating farmer would harvest all the soybeans as his 75-percent share and his incentive for planting and leaving the 100–120 acres of corn or milo unharvested to meet refuge purposes. While this option would save operational dollars, such a program would significantly reduce the amount of high protein clover crops and "green browse." To maintain similar benefits for wintering waterfowl and other wildlife, these important food resources would be replaced by top-seeding the harvested soybean fields with winter wheat or crimson clover in the fall, following soybean harvest. Because wintering waterfowl would totally consume these "green browse" crops, overseeding would not be economically feasible for cooperating farmers and, thus, necessitate that the work be done "force account" by refuge staff. Another more likely scenario and the one currently practiced would be for the cooperative farmer to plant up to 115 acres in soybeans on an 80/20 share (i.e. leaving 20% unharvested for wildlife) or

overseeding the acreage with winter wheat. Refuge staff would continue to plant all the corn, milo, and green browse acreage force account.

Regardless of the option, filter strips would be planted and maintained by refuge staff around each of the field units. Runoff would be directed into existing impoundment systems prior to entering natural waterways. Only annual cropland management plans that utilize BMPs and integrated pest management would be developed and approved by NRCS prior to implementing actions. Conservation tillage and no-till farming practices would be widely utilized and preferred over conventional methods. While animal waste is readily available and would be considered as a substitute to inorganic sources of fertilizers, the Service's Wildlife Disease Lab has recommended against use of organic fertilizers due to the potential of disease transmission. All crops, to the greatest extent possible, would remain unharvested to be utilized by wintering waterfowl, Neotropical migrants (birds and butterflies), endangered species, and other wildlife.

Standing crops, corn and milo, would only be manipulated (mowed or knocked down) after the waterfowl season to avoid conflicts with baiting laws. The unharvested corn crop would be aerially over seeded with annual rye grass or crimson clover to provide additional forage, soil stabilization, and improved water quality during winter. Cropland areas would be closed to public use to ensure undisturbed availability and utilization. A special effort would be made to plant corn and milo food plots in strips adjoining forest lands to provide supplemental food for Delmarva fox squirrels. Corn and milo fields would be set back from roadways by a minimum of 100 feet to minimize vehicular mortality to Delmarva fox squirrels that might be enticed to these food sources.

All cropland fields would be bordered by filter strips and buffers that contain and filter runoff. Immediately adjacent impoundment systems, that are diked to separate them and croplands from the natural wetland systems, would contain, hold, and filter all runoff before it would enter natural wetlands and waterways. No additional ditches or canals would be constructed; however, the existing infrastructure would be maintained. The 3:1 cropland rotation, in the preferred option, would eliminate the need to apply ammonium nitrate on corn crops in most cases, since the clover crops produce sufficient natural nitrogen (approximately 110 units per acre per year). The use of no-till and conservation tillage methods and equipment would significantly minimize erosion and siltation. Corn or milo crops would be followed by wheat or buckwheat cover crops in the preferred option to bind and utilize excess nitrogen created by waterfowl feces and clover rotation schemes. Similar effects would be achieved by planting winter wheat in harvested soybean fields if the second option was utilized.

Herbicide applications would consist only of previously approved, least problematic, least harmful compounds available to do the job, in accordance with Integrated Pest Management Plans (IPM). Pesticides would not be used except in the rarest of situations, when pests exceed threshold levels and are certified by the Agricultural Extension Office and IPM agent. An historical analysis of herbicide requirements in conventional versus no-till tillage and genetically modified seed use has been completed that supports the use of genetically modified crops (GMCs) to support refuge purposes and reduce use of chemicals. A request for a justifiable use of genetically modified seed has been forwarded to the appropriate approval authority. GMC's will only be utilized in the farming program after such said approval has been granted.

Annual monitoring programs would be implemented to evaluate the program's contributions to refuge purposes. Adaptive management techniques would be applied on all refuge lands.

(E) Why is the use being proposed?

There are significant statistics relating to the contributions that croplands on refuges make to waterfowl management and the achievement of refuge purposes. Publications such as Reinecke, et al. (1989); McFarland, et al. (1966); Ringelman, et al. (1989); and others, have repeatedly validated the scientific importance of cropland management to waterfowl. The success of these cropland management programs lies in the relatively large body size of waterfowl, which enables them to store fat, protein, and minerals for

later use. These reserves can then be mobilized for egg formation, migration, molt, or in times of food shortage. Although strategies for depositing and using nutrient reserves differ among species, and necessarily are dependent upon the seasonal availability of foods, cropland grains are among the most extensively exploited food resources (Ringelman 1990). Clutch size and perhaps nesting dates of mallards and Canada geese are thought to be directly related to the amount of reserves obtained on their wintering grounds. During breeding and molting periods, waterfowl require a balanced diet with high protein content. Grain crops, most of which are not very high in protein, are seldom used during these periods. However, during fall, winter, and early spring, when vegetative foods make up a large part of the diet and energy producing carbohydrates (hot foods) are the main nutritional requirement, grain crops such as corn and milo are preferred forage.

Corn and milo crops would be held standing and unflooded until made available by mowing or knocking them down during post-hunting season periods. The intended purposes of reserving these crops would be (1) to provide sources of high energy foods to build fat reserves prior to migration, (2) to provide food resources on the refuge to minimize depredation of winter wheat crops on adjacent private lands, and (3) to minimize long distance travel to food during the coldest periods of the year. Flight is the most energetic requirement for waterfowl, and by late January there are few areas left in the county where waterfowl have not already gleaned all waste grain thus necessitating long travel distances. For example, a 2.5-lb. mallard would require 3 days of foraging to replenish fat reserves following an 8-hour flight, if caloric intake were 480 kcal/day (the amount of intake from corn in an unharvested field) (Frederickson and Reid 1988). Refuge crops would be mowed or knocked down in strips at different intervals until the waterfowl migrated north to ensure a constant supply of fresh feed beginning in late January and continuing until mid-March.

Availability of Resources:
The infrastructure (cropland, dikes, drainage ditches, roads, and storage facilities) and equipment are currently available; that is, they would not need to be procured, constructed, or created. No new equipment or equipment replacement would be anticipated during the 15-year expected duration of this plan, since most equipment was replaced in 2001.

Cost Breakdown:

The following is the list of costs to the Refuge required to administer and manage the cropland management program as proposed in our preferred option utilizing a combination of force account and contractual plantings.

Refuge Planting/Maintenance(325 days @$140/day).....$45,500

Contractual Planting $45,000

Total.....$87,500

The following is the list of costs to the Refuge required to administer and manage the cropland management program as proposed utilizing force account and cooperative farming.

Refuge Planting/Maintenance(195 days @$140/day).....$27,300

Equipment/Seeds/Fertilizer ……..$20,000

Total.....$47,300

The following is the list of costs to the Refuge required to administer and manage the cropland management program as proposed utilizing entirely cooperative farming.

Refuge Planting/Maintenance(45 days @$140/day)..... $6,300

Equipment/Seeds/Fertilizer ……..…….. $8,000

Total.....$14,300

Anticipated Impacts on Refuge Purpose(s):

The following is a summary of the environmental, socioeconomic, and cultural/historical impacts of these programs as more thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment.

Effects on aquatic, wetland, and terrestrial habitats would be minimal. Again, only historical croplands would be cultivated. No new drainage systems would be created, and the actions used to minimize and mitigate runoff and erosion described above would result in very minor, if any, impacts on surrounding wetlands and aquatic systems. The approved CCP includes a reduction of cropland acreage from approximately 640 to 420 acres. Restoration of 220 acres of prior converted croplands to moist soil management impoundments and forested wetlands on Blackwater NWR, and a currently unknown amount of acreage within the Nanticoke protection area, would greatly improve the utilization of these lands for wildlife. Approximately 60 acres of historical cropland on Blackwater NWR would be reforested to provide connective travel corridors thus minimizing forest fragmentation on several isolated 50-acre tracts. Similar actions would be implemented on the Nanticoke protection area lands when opportunities were identified. Approximately 160 acres of cropland on Blackwater NWR and a currently unspecified amount in the Nanticoke protection area would be converted to moist soil management to benefit a diversity of waterbirds, shorebirds, and waterfowl (see the Moist Soil Management Program for further details).

The greatest impact of a cropland management program would be on wildlife populations, specifically wintering waterfowl, and to a lesser degree Neotropical migrants and endangered species. Cropland management has been used extensively on national wildlife refuges to provide food for migrating and wintering waterfowl and to lessen depredations on private cropland.

Surveys at several refuges showed that about one-third of all feeding by waterfowl was on cultivated crops. Seventy-five percent of the geese and 30 percent of the ducks using national wildlife refuges in the Southwestern States were harbored on refuges where cropland management was practiced. Three million birds were maintained for several weeks in California on three small refuges totaling only 17,000 acres, where cropland management was practiced to minimize private cropland depredation (Givens, et al. 1964). These are significant statistics relating to the contributions that croplands on refuges make to waterfowl management and the achievement of refuge purposes. Publications such as Reinecke, et al. (1989); McFarland, et al. (1966); Ringelman, et al. (1989); and others, have repeatedly validated the scientific importance of cropland management to waterfowl. The success of these cropland management programs lies in the relatively large body size of waterfowl, which enables them to store fat, protein, and minerals for

later use. These reserves can then be mobilized for egg formation, migration, molt, or in times of food shortage. Although strategies for depositing and using nutrient reserves differ among species, and necessarily are dependent upon the seasonal availability of foods, cropland grains are among the most extensively exploited food resources (Ringelman 1990). Clutch size and perhaps nesting dates of mallards and Canada geese are thought to be directly related to the amount of reserves obtained on their wintering grounds.

During breeding and molting periods, waterfowl require a balanced diet with a high protein content. Grain crops, most of which are not very high in protein, are seldom used during these periods. However, during fall, winter, and early spring, when vegetative foods make up a large part of the diet and energy producing carbohydrates (hot foods) are the main nutritional requirement, grain crops such as corn and milo are preferred forage.

The cropland management program, as practiced in these strategies, would also recognize the importance of high protein as a nutritional requirement during prebreeding and molting periods. Efforts would be made to make these crops available during the premolt and early migration periods to build and replenish protein. Ladino clover and buckwheat would be planted to provide sought after sources of protein, particularly for Canada and lesser snow geese.

Cropland grain is an abundant, high-energy food that can be quickly consumed by waterfowl (Ringelman 1990). The best indication of the nutritional quality of foods is given by an analysis of their chemical composition. The amount of gross energy, crude protein, fat, ash, fiber, and digestible carbohydrates (NFE or nitrogen-free extract) are indices to food value. However, since waterfowl use grains primarily as a high-energy food and supplement their diet with natural foods to compensate for nutritional deficiencies (Ringelman 1990), the energy content of grains is the most commonly used basis for comparison. Unfortunately, energy content varies among varieties of the same grain, as well as by soil and environmental conditions.

Moreover, waterfowl cannot digest different grains with similar efficiencies. In recognition of this digestive efficiency, metabolizable energy, which is indicative of the energy actually derived from a food, is a better comparative measure than gross energy content. Agricultural foods (with the exception of soybeans) provide high levels of metabolizable energy. Corn and milo are planted because they produce the highest amounts of metabolized energy, 4.01 and 3.85 kcal/g, respectively, for Canada geese (values four to 10 times greater than some of the natural plants such as smartweed and pondweed) (Fredrickson, et al. 1988). It should be noted that these values, while indicative of fresh seeds, are not representative of grains underwater or exposed outdoors for an extended period. Under these conditions, energy value may decline rapidly. For example, rice will lose only 19 percent of its energy value after 90 days of flooding, but milo and corn will lose 42 percent and 50 percent, respectively, and soybeans will lose 86 percent of their energy content. Such losses underscore the need for well-timed manipulations to maintain food quality.

Observations and censuses have demonstrated that many other resident and migratory bird species would also benefit from cropland management programs. In the summer, Eastern meadowlarks and several sparrow species use the clover fields. Since the winter wheat would remain unharvested and be left to mature, wild turkeys would use these fields as preferred nesting and brooding areas. Passerines seeking seeds or invertebrates would also heavily use the mature wheat. The eastern bluebird, in particular, seems to favor these areas during most of the year. Many species of raptors, including red-tailed hawks and kestrels, are often seen hunting in these areas. The once productive corn and milo fields would be left fallow throughout the summer to naturally succeed to warm season grasslands, which would be used for nesting and food by several Neotropical bird species.

Maintaining field borders would particularly benefit sparrow species, including song sparrows (*Melospiza melodia*), swamp sparrows (*Melospiza georgiana*), field sparrows (*Spizella pusilla*), chipping sparrows (*Spizella passerina*), white-throated sparrows (*Zonotrichia albicollis*), and savannah sparrows

(*Passerculus sandwichensis*) (Marcus, et al. 2000). Fields with field borders contain approximately three times the sparrows than fields without borders. Second only to its importance for waterfowl, the ladino clover would provide for a Lepidopteran spectacle. Literally millions of butterflies and skippers use these sweet clover fields throughout the summer and during early fall migrations. When they are kept mowed, the clover fields are perpetually blooming. Likewise, the planting of buckwheat fields, if properly timed, can provide impressive habitat for migrating butterflies.

The Delmarva Fox Squirrel Recovery Team has repeatedly recognized the importance of cropland management programs for the recovery of the endangered Delmarva fox squirrel. One of the recommended strategies is to supplement natural food resources by planting high energy crops (corn and milo) in areas adjoining forested tracts. Croplands can also attract squirrels to areas such as roadways, where mortality can occur. When corn and milo are planted near roadways, a 100-foot buffer of ladino clover would be planted between the corn or milo and the roadway. This practice would greatly minimize the enticement for squirrels to cross the roadways since they would be reluctant to travel over these long open distances, being fearful of avian predators.

Public Review and Comment:

The action contained in this compatibility determination was submitted to the public for review and comment in the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA. No comments regarding this action were received.

Determination: (Check One)

This use is compatible _X_

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:

Management will be in compliance with approved Best Management Practices and IPM plans. Cropland management has been conducted on Blackwater NWR annually since establishment in 1933. The attached cooperative farming restrictions, special regulations, and general operating practices have been structured to ensure compatibility. If monitoring determines that this use materially interferes with or detracts from fulfillment of the NWRS mission or purposes of the refuge, the use would be modified or curtailed, or eliminated.

Justification:

Cropland management has been an integral component of the development of Blackwater NWR since its establishment in 1933. In fact, expanding and changing cropland management practices first brought Canada geese to the refuge. Every year for the past 65 years, the refuge has used cropland management to produce large quantities of highly nutritious foods on relatively small areas to help offset the loss of natural foods caused by extensive marsh loss and degradation. Croplands are managed by the refuge to provide the most beneficial food sources for waterfowl and other wildlife. The proof of the success of these cropland management programs is the diversity and abundance of the wildlife that now depend on them.

Cropland management will not materially interfere with or detract from the mission of the NWRS or purposes for which Blackwater NWR was established.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 15 year Reevaluation Date: June 26, 2021

Attachments:

Figures E.1-E.7: Maps of fields undergoing cropland management activities

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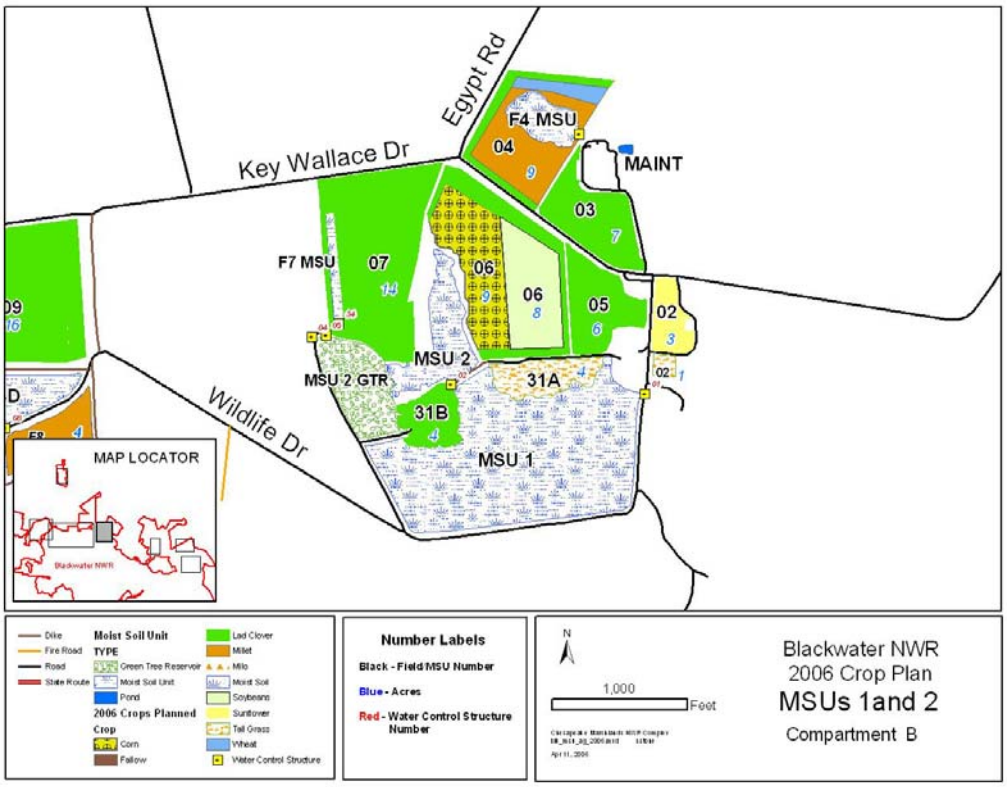

Figure E.1. Moist soil units 1 and 2

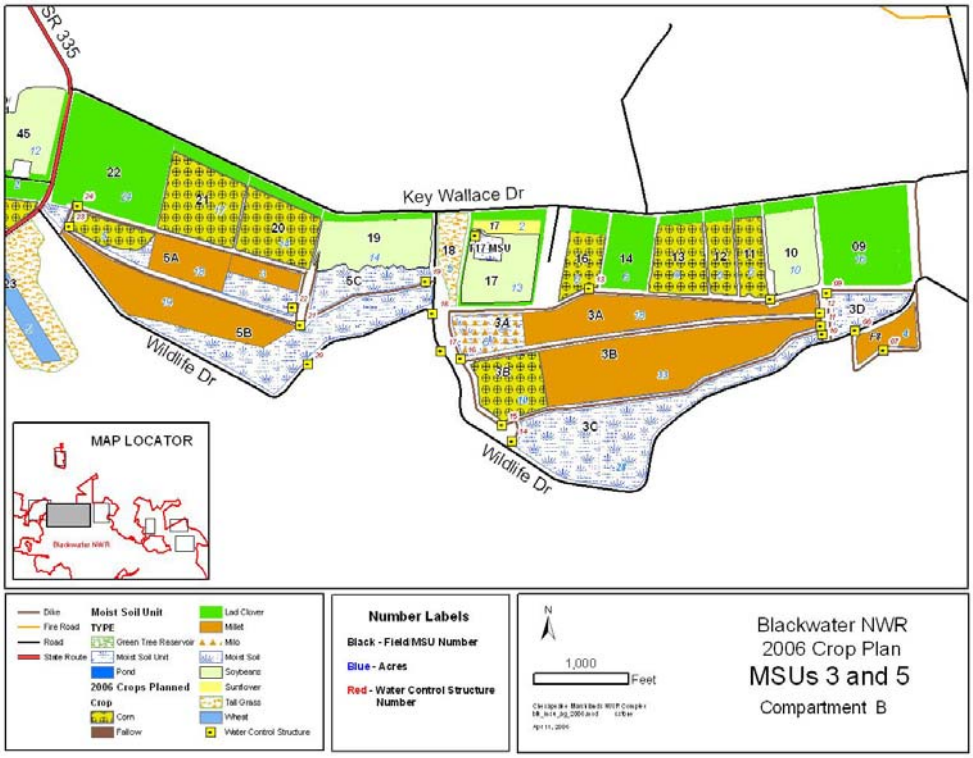

Figure E. 2. Moist soil units 3 and 5

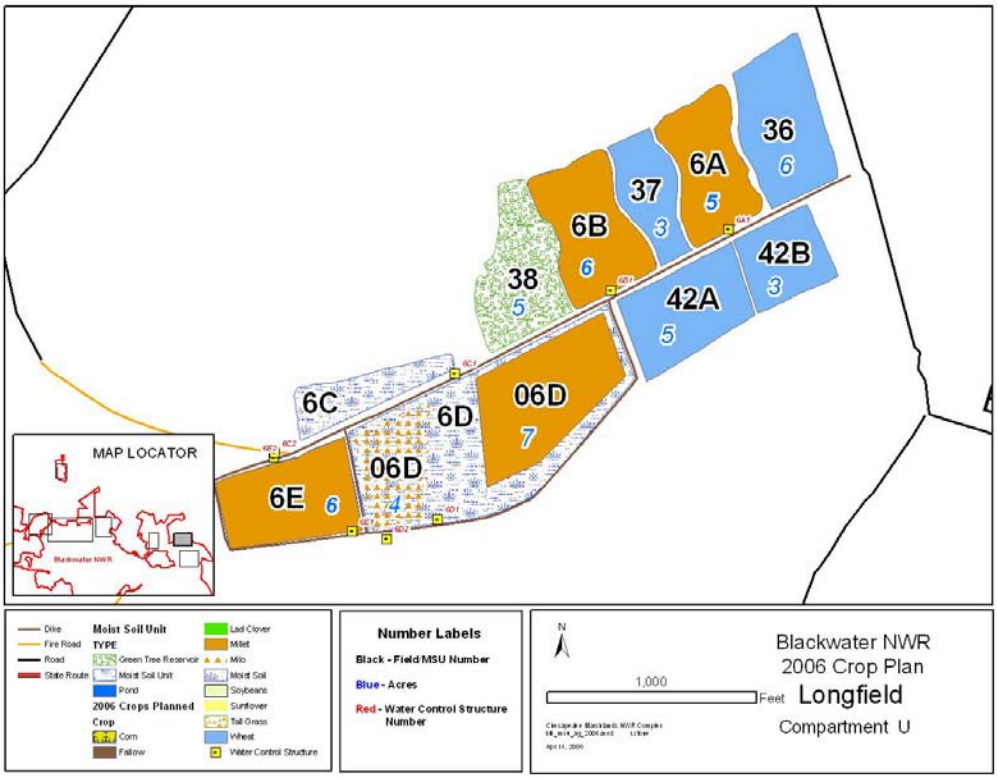

Figure E. 3. Longfield – Compartment U

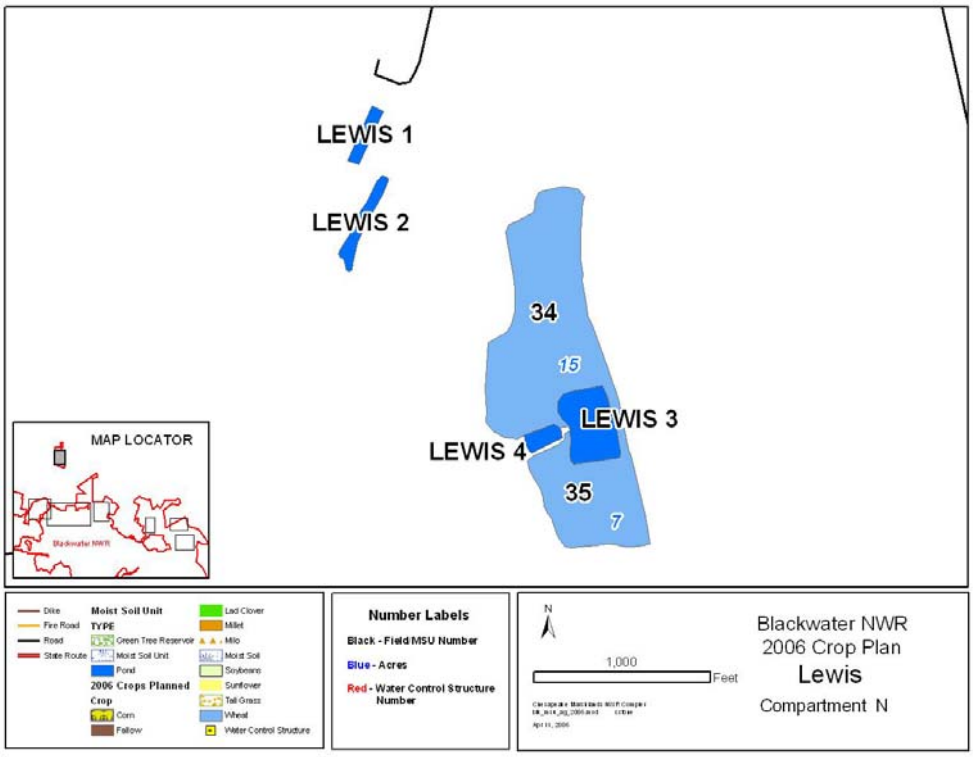

Figure E. 4. Lewis - Compartment N

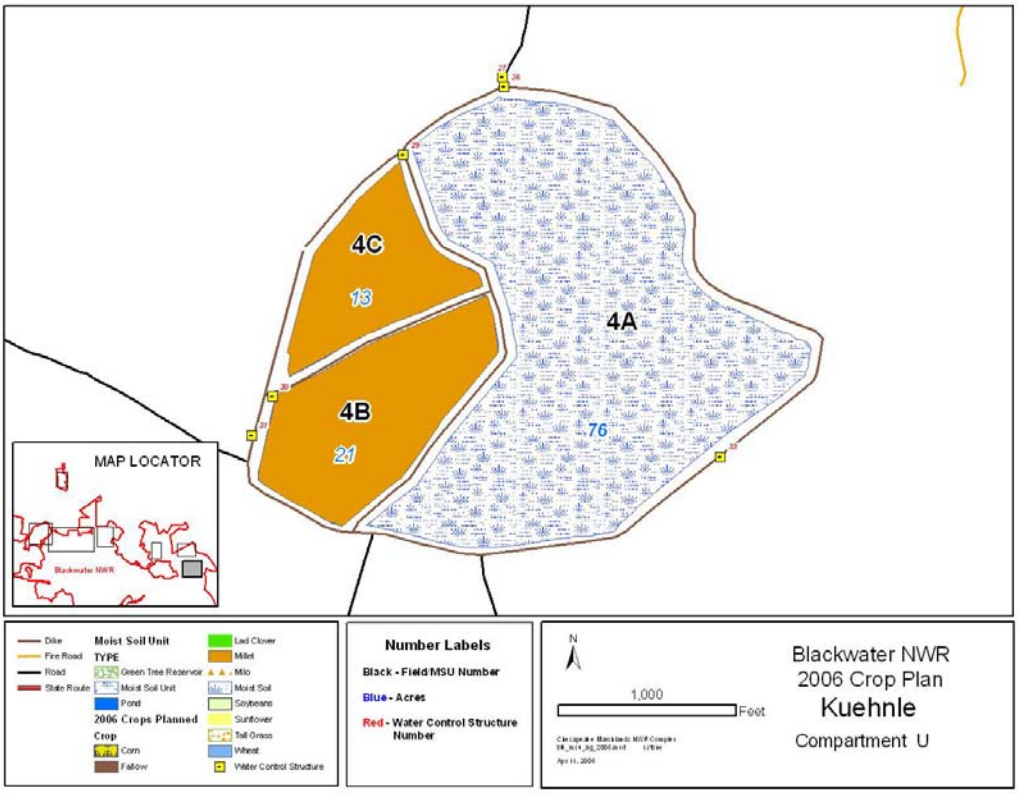

Figure E. 5. Kuehnle - Compartment U

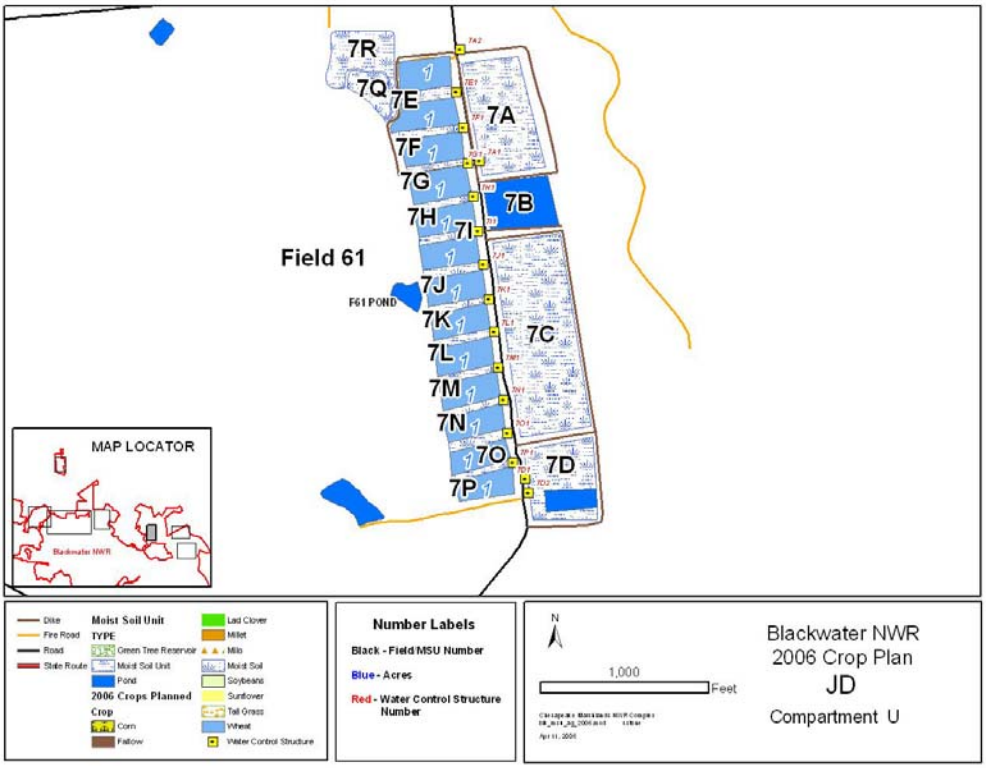

Figure E. 6. JD - Compartment U

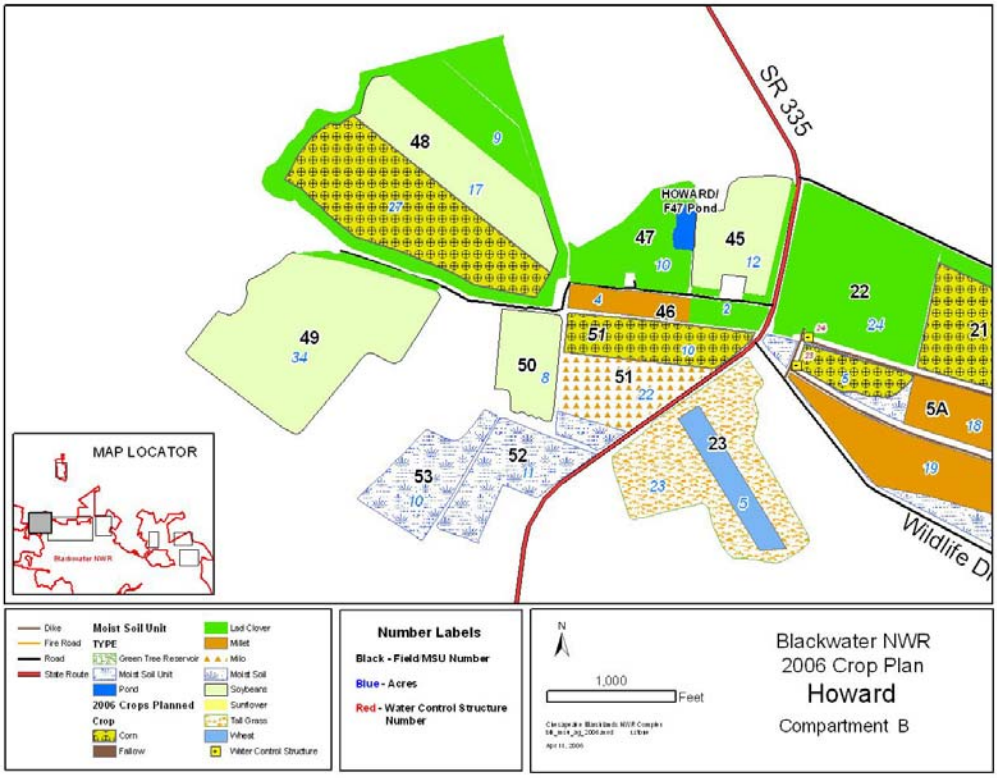

Figure E. 7. Howard - Compartment B

COMPATIBILITY DETERMINATION

Use: Fishing

Station Name: Blackwater National Wildlife Refuge (Chesapeake Marshlands NWR Complex)

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table I summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):

> For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."
>
> For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."
>
> For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."
>
> For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate

distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:
"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of fishing (and the associated facilities) with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is fishing (including construction of associated facilities as subsequently described). The National Wildlife Refuge System Improvement Act of 1997 identified fishing as one of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the act encouraged the Service to provide opportunities for these uses

Background and Rationale for the Management Activity
Fishing and crabbing have been sources of food and recreation on these areas since the Native Americans were the only inhabitants. However, when Blackwater Refuge was established in the 1930's, it was considered an inviolate sanctuary for wildlife. Because the refuge owned and regulated all the waters and water bottoms within the original acquisition boundary, all interior waterways were closed during the peak waterfowl migration and wintering seasons from October 1 to March 31 to prevent disturbance. Fishing was prohibited October 1 to March 31 for the same reason.

The waters on Blackwater Refuge are unmarked, shallow, and often revert to tidal mud flats at low tide making fishing very, very difficult. Because of the very shallow waterways, increasing salinities, and excessive turbidity resulting from marsh loss, fish populations are very low and the sizes of most fish species are small. Because public fishing opportunities that are not adversely influenced by these problems abound throughout Dorchester County, fishing and crabbing have not historically been active recreational pursuits at Blackwater Refuge.

The navigable waters of the Nanticoke River would not be subjected to refuge regulations should lands be acquired as a Division of Blackwater Refuge. Fishing and associated boating activities would be solely under the jurisdiction of the State of Maryland. Similarly, jurisdiction for regulating these activities on the Chesapeake Island Refuges would reside completely with the State of Maryland since the Service owns only to mean high water. Access to the river or to the waters of the Chesapeake Bay would be the only issue associated with these activities that the Service could regulate.

However, even with difficult access problems, the public expressed their desire during the CCP scoping process for more boat ramps and fishing opportunities (particularly access to the upper Blackwater River which is not subject to refuge jurisdiction). Increased fishing opportunities were therefore proposed during the CCP through the construction of a canoe ramp on Rt. 335 with a parking area, development of an

accessible boardwalk/pier along Key Wallace Drive on the Little Blackwater River, and improved mapping and marking of the Blackwater River channel. The historical, seasonally closed area (October 1 thru March 31) would be expanded from 5,788 acres to 6,223 acres in accordance with new legislation promulgated by Maryland DNR. Improved signage and printed materials, explaining Blackwater Refuge rules and regulations, would be made available to the visitor. Canoeing and boating activities would be monitored, and if necessary be restricted to reduce disturbance to wildlife and impacts to habitat.

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(B) Where would the use be conducted?

Fishing will occur on navigable and non-navigable waterways of the Blackwater, Little Blackwater, and Nanticoke Rivers and tributaries. However, authorization to control recreational fishing within the boundary of Blackwater National Wildlife Refuge (including the Nanticoke Division) is applicable only to those waters which are defined as "non-navigable," where title was vested in the United States in fee simple absolute, or where the State did not exert its claim during original acquisition (approximately 3,900 acres of waterways). Essentially, this means that the refuge has the authority to regulate fishing only on tracts (14), (14a-i), (14a-I,II), (14a-III), (14e-I), (16,a), (18), (19), (24,a-c), and (29). (See table E.1 for further details.) The refuge is not authorized to regulate fishing or other waterborne activities within the navigable waters of the State or within areas where water bottoms are State-owned. Therefore, for the purpose of explanation and definition, non-navigable waters within Blackwater Refuge include all refuge waters except: (1) the Blackwater River partially downstream of its confluence with the Little Blackwater River, (2) where the Service owns only to the centerline of the Blackwater River above and below the Highway 335 bridge, and (3) where the Government owns only to the centerline of the Little Blackwater River and Meekings Creek. Therefore, the compatibility of recreational fishing will be evaluated only according to effects on the purpose(s) for which these tracts where acquired. The construction of associated facilities, boat ramps, parking areas, and boardwalks/piers, will be assessed in reference to their respective tracts.

Shoreline access from refuge lands to waters within the Service's jurisdiction and control will not be authorized except for two fresh water, land locked ponds used for special refuge fishing events and environmental education programs on Tract 100u (Briggs Pond) and Tract 37 (Key Wallace Pond), respectively.

Access to the approximately 3,900 acres of refuge-regulated waters will be limited to one existing, off-refuge, public boat ramp at Shorter's Wharf bridge adjacent to Tract 52; a new proposed canoe/kayak ramp on Tract 100m adjacent to Star Route 335 near the Blackwater River bridge; or from any other "off-refuge" location. (NOTE: Fishing on the refuge will be further restricted by the very shallow tidal waterways that average less than 1.5 feet deep, except for the long meandering, unmarked Blackwater River channel which is approximately 3 feet in depth. Few visitors attempt to navigate their small boat or canoe any distance into this uncharted area because of these conditions. Even experienced refuge employees find it difficult to navigate refuge waterways.)

The proposed new canoe/kayak ramp will be constructed from a series of 12" x 2" x 8' concrete logs which will be designed to be used for canoe, kayak and non-motorized boats for wildlife/wildlands photography, wildlife observation, and fishing (all priority public uses), with an adjacent 350' x 48' parking area (space for about 10 vehicles) that will be constructed by Maryland Department of Transportation within the State's right-of-way (an area not subject to compatibility). The ramp will be constructed on lands owned by the U.S. Government (Blackwater NWR) while the parking area will be constructed on lands regulated by the Maryland Department of Transportation. The exact location for these facilities will be west of and adjacent to the State Route 335 bridge, and will provide safe access to the navigable (non-refuge regulated) waterway of the upper Blackwater River.

An accessible fishing pier/boardwalk (approximately 4' X 600') and associated parking area (200' X 25') are proposed for construction on Tract 14 to gain safe fishing access to the non-regulated waters of the Little Blackwater River. The proposed pier/boardwalk will be constructed on water bottoms owned by the State of Maryland (not subject to compatibility) and emergent marsh and uplands owned by the U.S. Government

(Blackwater NWR). The pier will extend from the immediately adjacent parking lot on refuge uplands approximately 200 feet over refuge marshland and then another 400 feet over State owned water bottoms and waters, along the south side of Key Wallace Drive, almost to the Little Blackwater Bridge. The associated parking area would be constructed in an adjoining refuge agriculture field.

(C) When would the use be conducted?
Fishing in refuge regulated waters would be allowed daily, from dawn to dusk (i.e. daylight hours only), April 1 to October 1, unless there is a conflict with a management activity or extenuating circumstance that would necessitate deviations from these procedures. Fishing during this time period would be further restricted by weather and summer insect infestations, factors that virtually eliminate all uses during June thru August, often extending into September. Fishing on the two freshwater ponds would be further limited to an annual event at Briggs Pond, and on special requests for environmental education programs at Key Wallace Pond. Since the proposed boardwalk/pier would be constructed over "navigable waters," fishing would not be regulated by the Service but by the State of Maryland in the impacted Little Blackwater River along Key Wallace Drive and the Little Blackwater Bridge area. Fishing in the upper Blackwater River would also be totally regulated by the State.

(D) How would the use be conducted?
Fishing and crabbing will be authorized and regulated according to provisions in 50 CFR, Subchapter C, Part 33 and consistent with State regulations. Fishing and crabbing will be restricted to opportunities from boats which provide the only access to refuge regulated waters of the Blackwater/Little Blackwater River systems. There will be no bank fishing or crabbing except for special fishing events and environmental education programs at Briggs Pond and Key Wallace Pond, and the proposed pier/boardwalk on the Little Blackwater River (regulated by the State of Maryland). Boat launching will not be permitted on the refuge except canoes and kayaks at the proposed canoe/kayak ramp near the Rt. 335 Blackwater River bridge. The uses described above will be regulated by distribution of refuge leaflets and state fishing and crabbing regulations at the Visitor Center. Law enforcement patrols and compliance checks by refuge officers will be used to enforce the provisions of 50 CFR, Subchapter C, Parts 26, 27, and 33, as applicable. Unmarked channels and depth of shallow water will limit the speed and distance traveled into the refuge by small motor boats. As previously mentioned, all uses on refuge-regulated waters will be expressly restricted April 1 to October 1. Staff and volunteers at the visitor center and the refuge office will also give instructions to visitors on how these uses are to be conducted. A boating, fishing and crabbing leaflet will be distributed at the Visitor Center.

(E) Why is the use being proposed?
Fishing will be conducted to provide compatible recreational opportunities for visitors to enjoy the resource and to gain understanding and appreciation for fish and wildlife. These uses will also provide wholesome, safe, outdoor recreation in a scenic setting, with the realization that those who come strictly for recreational enjoyment will be enticed to participate in the more educational facets of the public use program, and can then become advocates for the refuge and the Service.

Availability of Resources:
Additional staff would provide interpretive fishing, crabbing, and boat safety programs; National Fishing and Boating Week activities; preparation of canoe trails, maps, kiosk information, and signs; posting of navigation signs and boundary signs; and law enforcement of fishing, boating, and crabbing regulations within Blackwater Refuge.

Cost Breakdown:

The following is the list of costs to the Refuge required to administer and mange the fishing programs.

Service Costs

Interpretive programs (45 hrs @ $30/hr)	$ 1,350
National Fishing & Boating Week Event (9 hrs @ $30/hr)	$ 270
Preparation of signs, maps, trails, info (90 hrs @ $30/hr)	$ 2,700
Law enforcement of regulations (40 hrs @ $24/hr)	$ 960
Monitoring of canoeing and boating activities (20 hrs @ $16/hr)	$ 320
Brochures	$ 5,000
Signs	$ 5,000
Canoe Ramp	$ 1,000
Total	$ 16,600

Non-Service Costs Provided by Partnerships, Grants, and Donations

Construction of canoe ramp & parking area	$ 60,000
Construction of boardwalk/fishing pier & parking area	$200,000
Total	$260,000

Anticipated Impacts on Refuge Purpose(s):
The following is a summary of the environmental, socioeconomic, and cultural/historical impacts of these programs as more thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. Most of the construction impacts associated with facilities will occur on non-Service lands not regulated by the Service and not subject to compatibility. Impacts from fishing are anticipated to be minimized by closely monitoring impacts.

The continuation of the very limited number of fishermen using canoes (approximately 7 visits per year) will have very little, if any, effect on the refuge's wildlife, waterways, and adjacent habitats. Small motor boats could potentially affect the submerged aquatic vegetation, could create limited shoreline erosion from their wakes, and could potentially increase turbidity if there were sufficient numbers of visits. Zieman (1976) stated, "In shallow waters the most common form of rhizome disturbance is from the propellers of motor boats." Only an estimated 70 recreational fishermen per year currently use motorized boats, but most fishermen remain close to the Blackwater River channel where depths are greater and scouring of the water bottom is less likely. Because of the higher salinity and constant wind generated turbidity of the silt laden refuge waters, submerged aquatic vegetation (SAV) is almost nonexistent, therefore eliminating Zieman's concerns about destruction of SAV rhizomes (at least at Blackwater).

At Blackwater Refuge, fishermen can potentially interfere with migratory waterbirds present April 1 to October 1. Studies on boating disturbance of nesting waterfowl (Atkinson & Willes, 1969; Bouffard, 1982; Brickley, 1976; Cook, 1987; Coulter & Miller, 1968) and migratory waterbirds (Erwin, 1989) indicate that boating causes flushing of nesting birds and possible disturbance to nesting. However, Hartman (1972) found the wood duck, a prominent nesting waterfowl at Blackwater, quietly swam away instead of flushing. Evenson et al (1974) concluded that in spite of disturbance, ducks were never seen leaving the lake. In addition, Speight (1973) determined that the effects of waterfowl disturbance depended more on frequency of human presence than number of people present at one time.

Fishing can also potentially cause death or serious injury to migratory birds by using lead sinkers that can become ingested, or by discarding hooks, monofilament line, or other litter that can trap or entangle birds and other wildlife.

The concern, therefore, is whether or not these disturbances are sufficient to adversely affect the subject purposes for which the refuge was established. Since fishing and crabbing are limited to April 1 to October 1 when aggregations of migratory waterfowl are not present, and is further limited by access, weather, infestation of insects, and shallow water which limits water craft size and type, the major evaluation criteria will be the frequency of human presence.

Fishing in refuge regulated waters from a boat averages about one visit per day in April and May, and one visit per week from June through September. This equates to about 70 fishing visits annually. The daily frequency of human presence on approximately 3,900 acres of regulated waterways is therefore almost zero causing negligible wildlife disturbance. Since the limiting factors are not likely to change, the frequency of visitor use on refuge-regulated waters is also unlikely to change. The change will be in access to non-refuge regulated waters where the use is regulated by the State.

Fishing and crabbing on Blackwater Refuge waters, if authorized during the fall and winter, would have a negative impact on the migratory waterfowl and nesting bald eagles. Thus, Blackwater Refuge will continue to be closed to fishing and crabbing on refuge waters October 1 - March 31. The increase from 5,788 acres to 6,223 acres of closed area (marsh that has been changed to open water) will prevent increased visitor disturbance to migratory waterfowl. Although the fishing and crabbing facilities would be increased, the shallow water and closure during 6 months of the year would contribute to having little to no impact on fish and crabs from fishing and crabbing visitors.

Although there are 34 million anglers in the US, few would come to the Blackwater Refuge to fish simply because Blackwater Refuge is not noted for its sport fishing.

The proposed accessible boardwalk/ pier, kiosk, and parking area near the Little Blackwater Bridge would provide a popular fishing area not found anywhere else in the County. It would draw many people who do not own or have access to a boat to fish. It would eliminate the parking problem and safety hazards along the County roadway, and thus, deterioration of the roadway and erosion control from illegal parking. It would also provide an accessible fishing area where presently there are none on the Blackwater Refuge and few, if any, in Dorchester County. For the most part of the year, the pier would be used not for fishing but for wildlife observation.

Interpretive signs, maps, and river channel markers will be provided to increase safety and prevent physical impacts by allowing the fisherman/boater to follow the channel instead of getting lost in the unmarked shallow water. The continued closure of boating October 1 - March 31 and the proposed increase in the size of the seasonal closed area at Blackwater Refuge would have a positive physical impact on the environment. Since there would be no additional facilities proposed for the NanticokeDivision or Chesapeake Island Refuges, there would be no impacts to physical resources.

There would be no cultural or historical resource impacts expected.

Public Review and Comment:
This compatibility determination was submitted for public review and comment as an appendix to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X_

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
Fishing on Blackwater Refuge has been conducted for many years. The continued closure of boating October 1 - March 31 and the proposed increase in the size of the seasonal closed area at Blackwater Refuge have been implemented to ensure compatibility. If the monitoring described under Availability of Resources indicates that this use materially interferes with or detracts from fulfillment of the National Wildlife Refuge System mission or the purposes of the refuge, we would curtail or eliminate the use.

Special Regulations governing our fishing programs will be codified in the Code of Federal Regulations, Title 50 and will be subject to Maryland State regulations and the following special refuge conditions:

1. We allow fishing and crabbing from April 1 through September 30 during daylight hours only.
2. We restrict fishing and crabbing to boats and the Key Wallace roadway across the Little Blackwater River.
3. We require a valid Maryland sport fishing license. We do not require a refuge permit.
4. We require all fish and crab lines to be attended.
5. We prohibit boat launching from refuge lands except for canoes/kayaks at the canoe/kayak ramp located near the Blackwater River Bridge on Route 335. A public launching ramp is available at Shorter's Wharf.
6. We prohibit the use of air boats on refuge waters.

Justification:
Recreational fishing is compatible because of the extremely limited visitation and the very limited direct and indirect effects on the refuge's 3,900 acres of waterways or approximately 17% of the refuge that was acquired for the purpose "as an inviolate sanctuary, or other management purpose, for migratory birds." The restrictions that Blackwater Refuge places on these activities; the public outreach; the enforcement and educational efforts; the shallow waters, and difficulty in navigation which severely limits opportunities for use, all combine to keep these uses compatible.

Fishing will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the Refuge was established.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 15 year Reevaluation Date: June 26, 2021

Attachments:
Table E.1. Land Acquisition History

Closed to boating and thus fishing areas October 1 - March 31 (figure E.8)

References:
Atkinson-Willes, G. 1969. Wildfowl and recreation: a balance of requirements. Br.Water Supply. 11: 5-15.

Bouffard, S. H. 1982. Wildlife values versus human recreation: Ruby Lake NationalWildlife Refuge. Trans. N. Am. Wildlife National Resour. Conf. 47:553-558.

Buckley, P. A., and Buckley, F. G. 1976. Guidelines for protection and management of colonially nesting waterbirds. N. Atlantic reg. Off., NPS, Boston, Mass. 54pp.

Cooke, A. S. 1987. Disturbance by anglers of birds at Grafham Water. ITE Symposium. 19:15-22.

Coulter, M. W., and Miller, W. R. 1968. Nesting biology of black ducks and mallards in northern New England. Vermont Fish and Game Dep. Bull. 68(2):74pp.

Erwin, R. M. 1989. Responses to human intruders by birds nesting in colonies: experimental results and management guidelines. Colon. Waterbirds. 12(1):104-108.

Hartman, G. W. 1972. The biology of dump nesting in wood ducks. M.S. thesis, University of Missouri-Columbia. 66pp.

Speight, M. C. D. 1973. Outdoor recreation and its ecological effects: a bibliography and review. University College London, England, Discuss. Pap. Conserv. 4. 35pp.

Ziemer, J. C. 1976. The ecological effects of physical damage from motor boats on turtle grass beds in southern Florida. Aquat. Bot. 2:127-139.

Table E.1. Land acquisition history (Blackwater NWR)

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
1/13/33	18	1.00	Graveyard Tract	MBCA
1/13/33	19	72.00	Blackwater R.	MBCA
1/23/33	14,a,-I,-II,-III,b–g,i	8,167.99	Delmarvia Fur Farms	MBCA
12/01/42	16,a	355.18	Kuehnle	MBCA
8/02/45	24,a–c	2,203.21	Seward	MBCA
4/21/51	29	416.94	Smith	MBCA
6/22/72	37	408.40	Luthy	MBCA
6/23/72	38	1.15	Brooks	MBCA
6/29/72	31	1.28	Turner	MBCA
6/27/75	45,R	175.10	Spicer	ESA
5/15/78	45b–d	1,610.47	Jarrett	ESA
9/28/78	45a–e	852.84	Jarrett	ESA
10/09/84	58,-I	489.50	Handley	ESA
4/19/85	53,-I	863.00	Herman Robbins Est.	MBCA
4/20/64	41,R	0.00	State of MD Easement	MBCA
11/05/76	2	7.14	State of MD Exchange2	80 STAT. 926
3/02/77	14d	(9.89)	State of MD Exchange3	16 U.S.C. 668dd
8/11/87	54	71.40	Schmidt	RRA
10/21/87	55,-I	237.20	Wm. Robbins	RRA
11/02/88	99,R	445.00	Paul Handley Est.	MBCA
11/09/88	52	297.20	Rufus Robbins	MBCA
4/09/91	100	454.20	Pascal	MBCA
10/21/91	51,-I	562.70	Gregg	MBCA
12/24/91	100a–i	176.75	Barren Island	MBCA
12/30/92	101	797.78	Williams	MBCA
12/28/92	100m	459.47	Howard	RAA
12/30/92	100j	380.00	Bishops Head	RAA
12/30/92	100k	52.00	Spring Island	RAA
2/28/94	100n	856.00	Madison (Ewing)	NAWCA

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
8/10/94	59	201.00	Mills	MBCA
11/2/94	103	299.95	Burton	MBCA
2/7/96	100t	173.85	Elliott	MBCA
12/28/95	104a	324.34	Valiant	MBCA
5/23/96	100r	55.23	Rasche	MBCA
8/6/96	100u	1,163.06	Linthicum	MBCA
7/29/96	100p,q	431.26	Lakes	MBCA
12/16/97	100Ae	149.73	Williamson	MBCA
9/24/99	108	74.88	Spicer	MBCA
9/24/99	107r	748.26	Spicer	MBCA
7/26/99	100Af	26.50	Long	MBCA
3/29/99	105,a	174.48	LeCompte	MBCA
3/28/00	100Ag	64.73	Riggins	MBCA
6/29/72	31	1.28	Turner	MBCA
3/15/00	54a	141.60	Schmidt	MBCA
2/6/02	100Ah	109.81	Newcomb	MBCA
2/20/02	100Ai	89.25	Newcomb	MBCA
6/26/93	102	0.11	Wooten	MBCA
7/8/00	106	149.06	Stanley	MBCA
6/28/00	111	139.10	Elliott	MBCA
1/4/00	113	215.80	Lewis	MBCA

[1]MBCA: Migratory Bird Conservation Act; ESA: Endangered Species Act; RRA: Refuge Recreation Act; NAWCA: North American Wetlands Conservation Act; RAA: Refuge Administration Act

[2]Received in an exchange with the State of Maryland for land of equal value

[3]Given in an exchange with the State of Maryland for land of equal value

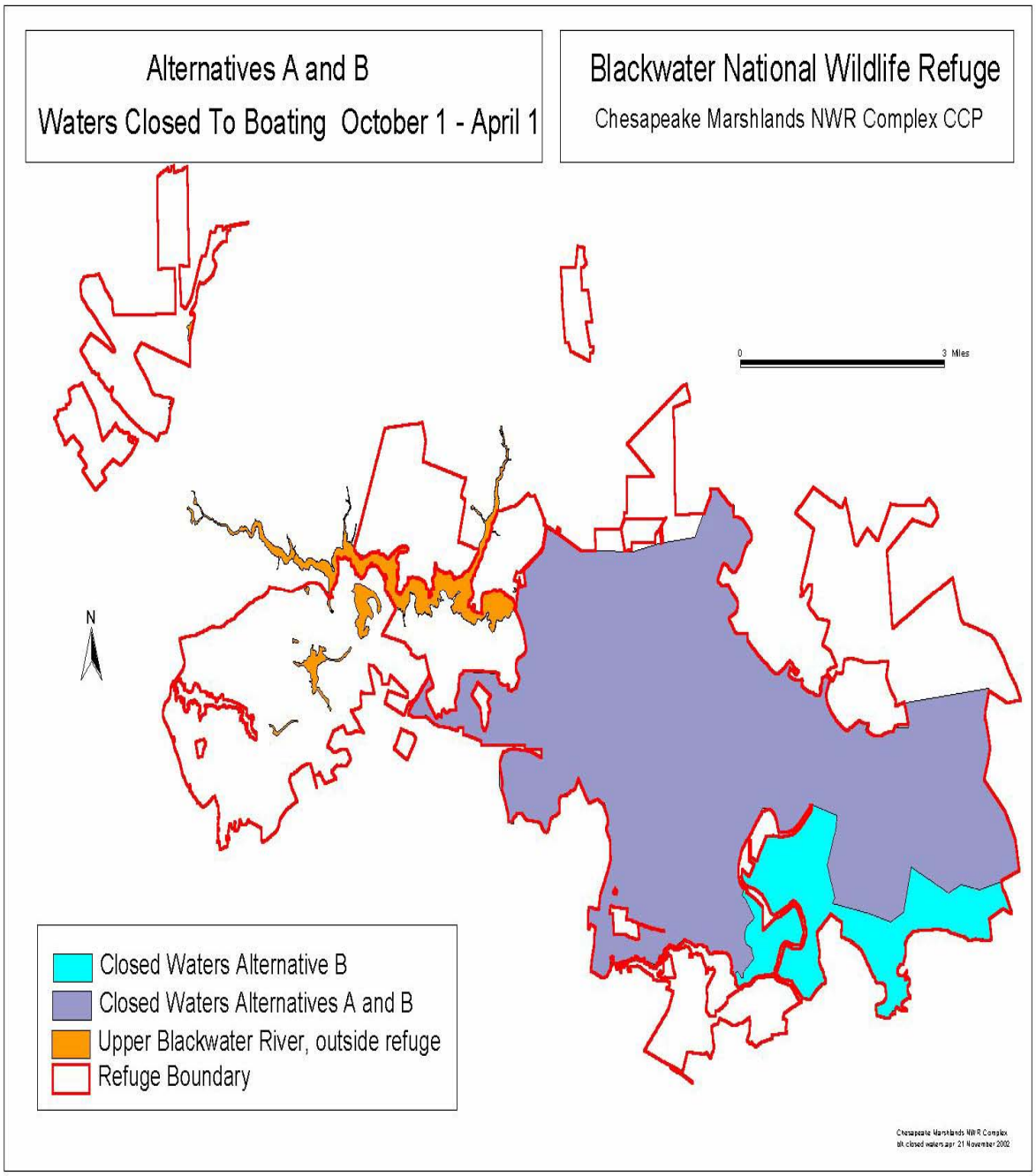

Figure E.8. Areas closed to boating

COMPATIBILITY DETERMINATION

Use: Harvesting of Forest (wood) Products

Station Name: Blackwater National Wildlife Refuge

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table I summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):

> For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."
>
> For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."
>
> For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."

> For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:

"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of utilizing commercial forest management practices to create and restore seven forest cores each having a minimum of 865 acres needed to support 11 of the most highly area sensitive forest interior dwelling bird species, many of which are neotropical migrants.

(A) What is the Use? Is the use a priority use?
The commercial harvesting of forest products will be performed for the primary purpose of improving wildlife habitat and ensuring that a diversity of forest habitat types are perpetuated for many generations to come. The specific types of commercial harvest which will be performed include timber stand improvements such as thinnings and release cuttings which could result in the sale of poles, pulpwood or firewood; regeneration cuts such as seed tree, selection or shelterwood cuts which would yield products ranging from pulpwood to saw timber; and salvage cuts performed as a result of storm, insect or disease damage which could result in the sale of any or all of the above mentioned forest products. Commercial management practices are the preferred method over using force account due to the fact that the refuge system does not own the equipment necessary to perform the tasks properly without causing significant negative impacts to the sites. Nor does the Refuge have the manpower to either run equipment or harvest trees using chainsaws. Commercial timber management is the most economical, safe and environmentally sound method of achieving many of our proposed forest management objectives. It is also imperative that fund generated from the sale of forest products be returned to the refuge in order to ensure proper restoration of the forest and help support the management and/or restoration of additional forest habitats since there is no actual funding provided from the Service to support forest management activities on refuges.

Background and Rationale for the Management Activity

Blackwater National Wildlife Refuge is currently 36 percent forested and is comprised of some of the largest remaining contiguous tracts of mature forests on the Delmarva Peninsula. The forests of Blackwater are also home to several federally endangered plant and animal species such as the Delmarva fox squirrel *(Sciurus niger cinereus*), Southeastern Bald Eagle (*Haliaeetus leucocephalus*), Swamp pink *(Helonias bullata*), and Sensitive joint-vetch (*Aeschynomene virginica*) as well as many other Fish and Wildlife Service trust species (see attached Complex's CCP for a full species list). Other equally ranked species groups of concern are Neotropical Migratory songbirds, specifically Forest Interior Dwelling species (FIDs). FIDs generally require large expansive tracts of interior forest for breeding. BNWR consists of and protects some of the last remaining large contiguous tracts of forested land in Dorchester County. The

upland and wetland forested areas surrounding BNWR continue to be cleared and converted to residential areas, agriculture lands or pine monocultures. Therefore, it is essential that this habitat type be protected, maintained, and actively managed to promote healthy populations of fish, wildlife and plants. Forest management objectives and strategies will focus primarily on the enhancement of forested habitats for the above-mentioned trust resources.

In addition to performing forest management to enhance habitat for trust resources and promoting a healthy and diverse ecosystems, the FWS and BNWR have been subject to increased public scrutiny. Locally, BNWR has been criticized for the lack of forest management performed on its land. Much of the forested land acquired by BNWR was and/or is, in less than desirable conditions as a result of historical, as well as previous land owners' poor forest management practices and the lack of planning for future habitat conditions. A large percentage of the earlier acquired forested land (1933 - 1969) was either recently cleared or in an early stage of succession (<30 years). Much of the typical loblolly pine /oak and loblolly pine/hardwood forests that once dominated the landscape have been converted to low quality mixed hardwood stands through a harvest technique called "high grading." High grading is the removal of the most commercially valuable trees from a stand, leaving a residual stand composed of trees of poor condition or undesirable species composition. High-grading is not considered silviculture due to the dysgenetic effects and long term economic and forest health implications (Helms, 1998). High-grading is "taking the best and leaving the rest" (Jastrzembski, 1999). In most cases the preferred timber species was, and continues to be, loblolly pine for saw timber, pulp wood and poles. A viable hardwood market is essentially non-existent on the Eastern Shore, thus resulting in either some degree of residual canopy or extremely heavy slash loads which have detrimental effects on natural regeneration of loblolly pine as well as preferred mast producing hardwoods. At the time of purchase, the rehabilitation of these tracts was left to natural processes. Some of these stands have regenerated successfully and matured into healthy stands containing both pine and hardwoods in the canopy, while other stands have not been as successful in their response to the disturbance and have not regenerated. This in turn resulted in a conversion in cover type or possibly habitat type. More recently (1970 - present) BNWR has been acquiring a higher percentage of lands containing mature forests. However, there are still a significant number of stands that were harvested (clear-cut or high graded) or mismanaged prior to acquisition which are in need of intensive silvicultural treatment in order to restore a healthy forest.

The overarching goal of the proposed Forest Management Program at Blackwater NWR (to be expanded to include the Nanticoke Division) will be to maintain and increase the size of 7 contiguous, mature forest cores from a minimum of 400 acres to as large as 865 acres. Management strategies will include reforestation, strategic land acquisition, regrowth of cutover areas, timber stand improvement of existing stands, and regeneration cuts. The latter, will in most cases, target forest stands that are exhibiting signs of declining health; to a lesser extent, regeneration cuts will also be used to influence species and age class diversity. Blackwater NWR also contains 1270 acres (15 %) of recently cut over stands ranging from 0 to 15 years in age and 227 acres (3%) of immature stands ranging in age from 16 to 40 years old. With proper management, these stands will eventually develop into quality DFS and FIDs habitat, some of which will become part of an existing core or become cores on their own.

Both even and uneven-aged systems will be employed to enhance and expand the core areas and create new cores. A wide variety of silvicultural techniques may be applied within each core to maintain forest health and desired species and age class composition. Silvicultural prescriptions known as Timber Stand Improvements will be crucial in managing the cores and include the following practices: thinnings, release cuttings, salvage cutting and sanitation cutting. In most of these stands, mast production could be significantly improved through release cuttings, understory reduced through burning and stress reduced through thinnings. Other management techniques such as single tree and group selection, shelter-wood regeneration cuts, and pesticide/herbicide applications will also be utilized to improve forest stands within and outside core areas. Seed tree harvests may also be performed outside or within a core but only if adjacent (*i.e.*, contiguous) forested land of similar size and quality can be incorporated into the core as they reach maturity or are acquired. Areas in which forest management activities result in gaps in the canopy

greater than 30 meters wide will be excised from the core until such time that the gaps have closed up. Consequently, the core can be envisioned as dynamic, moving about in both space and time. Once a core has been established (minimum of 400-acres), our goal will be to maintain that acreage regardless of the forest management activities, with the exception of catastrophic events (i.e., weather, insect, disease). Forested areas which are not part of a core will be more intensively managed to maximize forest health and promote optimal survivability and growth for the purpose of incorporating them into existing or new cores. This may require that some of the previously mismanged (i.e., high-graded), neglected or degraded (i.e. gypsy moth mortality) areas be completely cleared and restored to a healthier more vigorous stand of a desired species composition.

Well-managed forests are healthy forests. Healthy forests filter pollutants from the air, produce oxygen that we breathe, cool off the land, and improve the quality of our water. Well-managed forests are beautiful. The most appealing forests you have seen, those that are inviting to walk through, are probably forests that have been recently thinned. Timber harvests are essential to our way of life. Not only for the wood and paper products they provide, but also for the beautiful, healthy forests they help create (Jastrzembski, 2000).

Silviculture involves managing and handling the forest in view of its silvics. Silviculture imitates a natural change such as a windthrow, beetle infestation, or fire. However, silvicultural methods harvest forests products for human use rather than wait on nature to burn them, eat them, or blow them down. Silviculture can be practiced at any time in the life of a timber stand. Southern pine management is an excellent example of silvicultural treatments throughout the life of a stand. However, in Appalachian hardwoods, 90 to 100% of silviculture is decided and carried out at the time of a timber harvest (Jastrzembski, 2000).

Some tree species thrive in shade; sugar maple, beech, hemlock, dogwood, red maple and basswood are good examples. These species can live, grow, and reproduce in shade and semi-shade conditions. Many tree species prefer or require full sunlight; yellow-poplar, walnut, some oaks, loblolly pine, and hickory are good examples. These species require full sunlight to reproduce, after which they grow best in full sunlight or as part of the overstory canopy of the forest. They also tend to be the fastest-growing species and, to a great extent, the most valuable species. Still other species such as white pine, white ash, and some oaks, are intermediate in their sunlight requirements.

Additionally, as with all forest communities, the woodlands of BNWR are impacted by a variety of both exotic and indigenous forest pests and diseases. The susceptibility to both insects and disease is directly related to stand conditions and forest health. Forest insect pests in particular have the ability to key in on tree stress and therefore targets stressed or unhealthy forests first. Once established, these pests can reach epidemic levels and spread to healthy forests. There are several natural processes occurring on and around BNWR which are negatively affecting forest health. Accelerations in sea level rise, other permanent alterations in drainage and climate are processes which we cannot control. However, nearly all other stressors as well as insect or disease outbreaks can be prevented or managed by improving forest health through silviculture.

(B) Where would the use be conducted?

The following cores were delineated based on the criteria relating to minimum breeding area requirement for FIDs as described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan and the Forest Management Plan for Blackwater NWR of which this document is an attachment. The criteria describes cores of having to be a minimum of 400 - contiguous acres of forests which are greater than 40 years old (ie. mature). The current refuge land base has been delineated to create four cores of 400-acres or greater and two cores less than 400-acres which exhibit the greatest potential for becoming cores. A seventh core will be established in the near future through land acquisition. Figure E.9 below demonstrates the size and location of the four current cores. Figure E.10 displays all seven cores in their 'unmanaged' condition as well as the projected or desired future condition of all seven cores. Although all cores are representative patches of contiguous mature

forest of a minimum size and developmental stage, each core is dynamic in the fact that they are essentially revolving in both space and time. Although the general location and minimum size of a core will not change, the actual boundaries of, and forest conditions within a core, may shift as management activities are carried out or new lands are acquired. A core may not always consist of the same physical forested acres. For example: As stands within a core reach the point of over-maturity and declining health, these stands may be harvested (removed from the core), but only when adjacent parcels of forested land of equal or greater value can be incorporated into the core to offset the decrease in patch size and effective area. Once four of the seven cores reach the optimum size of 865-acres, that acreage will then be maintained as the core's minimum size. The proposed management for each of the seven current and potential cores as well as other stands within core compartments will be prioritized based on what types of management are most likely to be accomplished with the least amount of conflicts. In most cases, the ranking for proposed forest management aimed at improving the integrity of the core will be timber stand improvement, reforestation/restoration, regeneration cutting, and controlling problem vegetation to release regeneration. A series of priority management strategies will be described both narratively and most importantly, geographically. Geographically displaying these management strategies within and around the designated core areas will provide a better understanding of the ecological significance of the management prescriptions proposed.

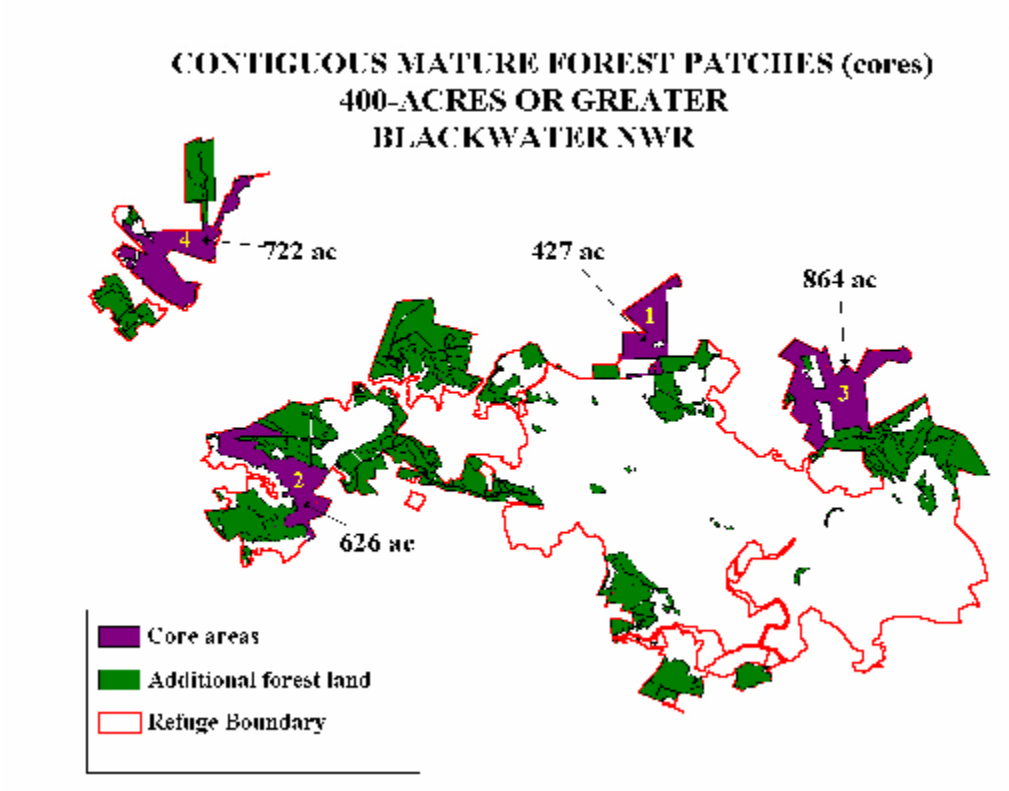

Figure E.9. Map of four currently established forest cores.

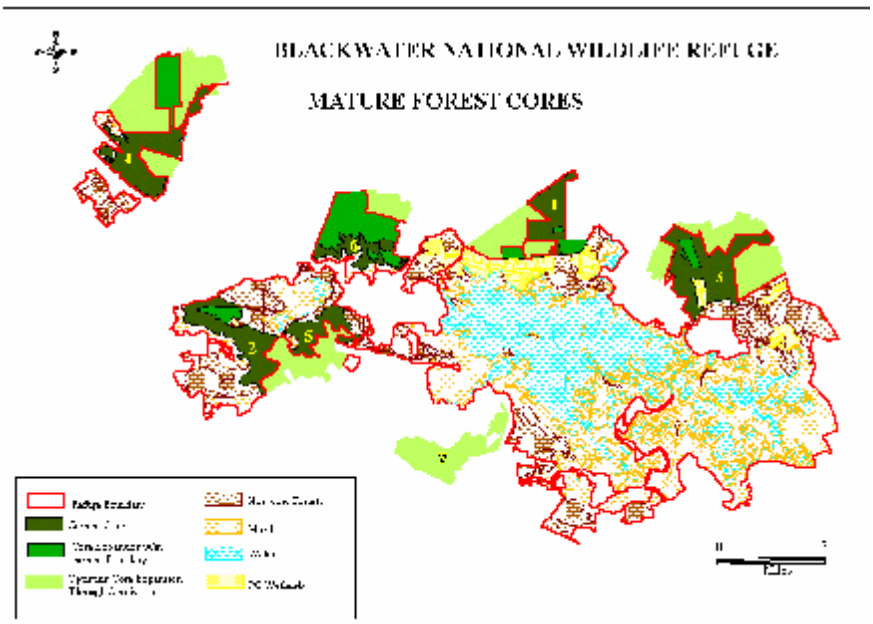

Figure E.10. Map of all seven cores displaying current or unmanaged conditions as well as desired future conditions.

A.) Core 1

Core 1 is a subset of forested habitats within compartment D. Core 1 was delineated by grouping all contiguous mature and over-mature stands within the compartment. The current core is comprised of 427 contiguous acres of mature and over-mature loblolly pine/hardwood forest. A more detailed description of the forests in this compartment can be found in the Affected Environment Section of this plan and the Forest Management Plan. A closed canopy road extends South to North bisecting the entire core and a secondary closed canopy road also exists in the western part of the core. The fact that these roads are narrow and are closed canopy makes them an insignificant detriment to the integrity of the core. The core is however, negatively impacted by a 9-acre abandoned field which serves in part as the refuge's bone yard. The current effective area of Core 1 within the 100-meter buffer is 209-acres and the perimeter to area ratio is 86 (figure E.11). The following forest management prescriptions have been determined to be the highest priority for improving the quality of this core. The proposed actions and consequences will be described and geographically displayed.

1.) Timber Stand Improvement.

The highest ranking management recommendation consists of performing TSI in the 71-acre stand of immature loblolly pine and hardwoods directly adjacent to the core. The stand is dominated by very dense 30-year-old pines and hardwoods with a remnant canopy of over-mature pines. In addition to an overstocking of pine, the stand also contains a high percentage of sapling and pole size oaks of various species. The future of this oak component is severely limited by the high degree of competition from pines and less-desirable, more vigorous hardwoods. The effects of competition on oak ability to become established in the canopy are already evident. Due to their slower rates of growth and density of the stand, the oaks quickly being suppressed. In order to promote and ensure the establishment of both pines and oaks in the upper canopy of this stand prior to becoming incorporated into the existing core, it is recommended that a 'Crop tree release' be performed in this stand to reduce competition and improve growth and vigor of preferred mast producing species hardwoods and pine.

By significantly decreasing the competition for resources throughout the stand and targeting a specific number of preferred tree species for release will improve tree growth and mast production and ensure that this stand will be a healthy and beneficial addition to the core. The increase in tree

growth and mast product will provide tremendous benefits for DFS as well. By adding this particular stand, the overall size of the core is increased by 16.71 percent, and the effective area is increased by 16.67 percent (34.76-acres). The perimeter to area ratio is also decreased from 86.08 to 80.47 (6.5 % decrease). By adding such a significant parcel to the core, it will allow for the regeneration or restoration of some of the older, less vigorous and unhealthy portions of the core without significantly impacting the effective area of the core. This management prescription will not result in any changes to species competition, but will directly affect stem density and stand structure for the benefit of DFS, FIDs and all wildlife. Figure E.12 below demonstrates the consequences of implementing prescription A and how the core would be improved by the addition of this 71-acre stand. Since the age of this stand is slightly over 30-years and our definition of mature forests states an age of 40-years, this 71-acres stand will be incorporated into the core in less than 10-years. This map also provides excellent visual explanation of the consequences of each prescription.

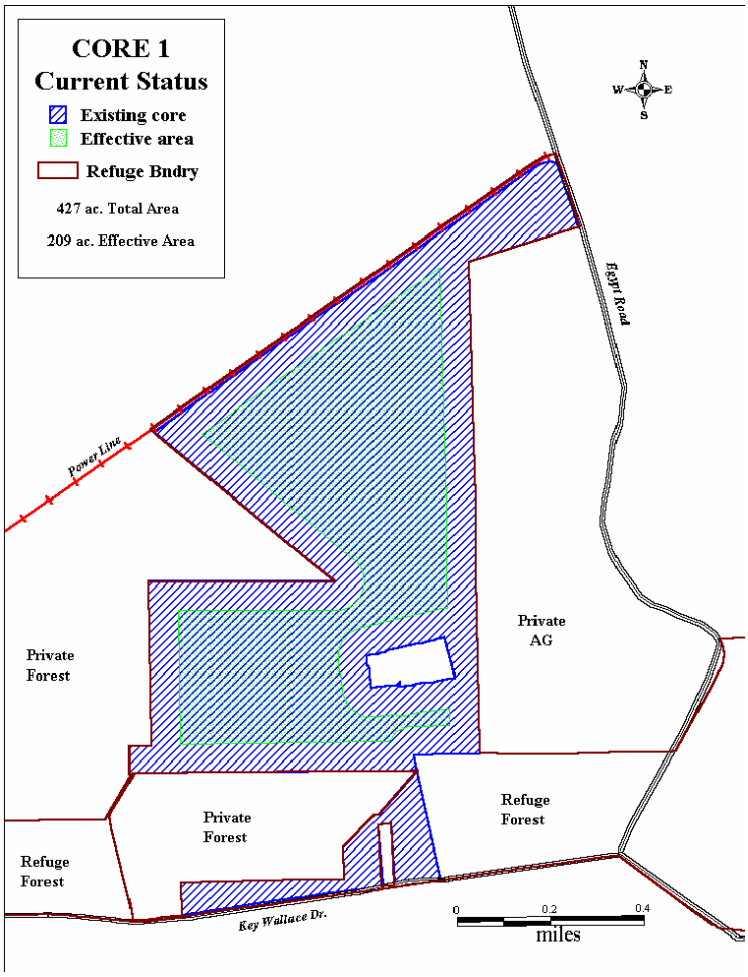

Figure E.11. Core 1

2.) Regeneration Harvests

Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 250-acres of mature and overmature forested habitat within this core over the next 15-years. The proposed acreage is based on current conditions and current land base. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

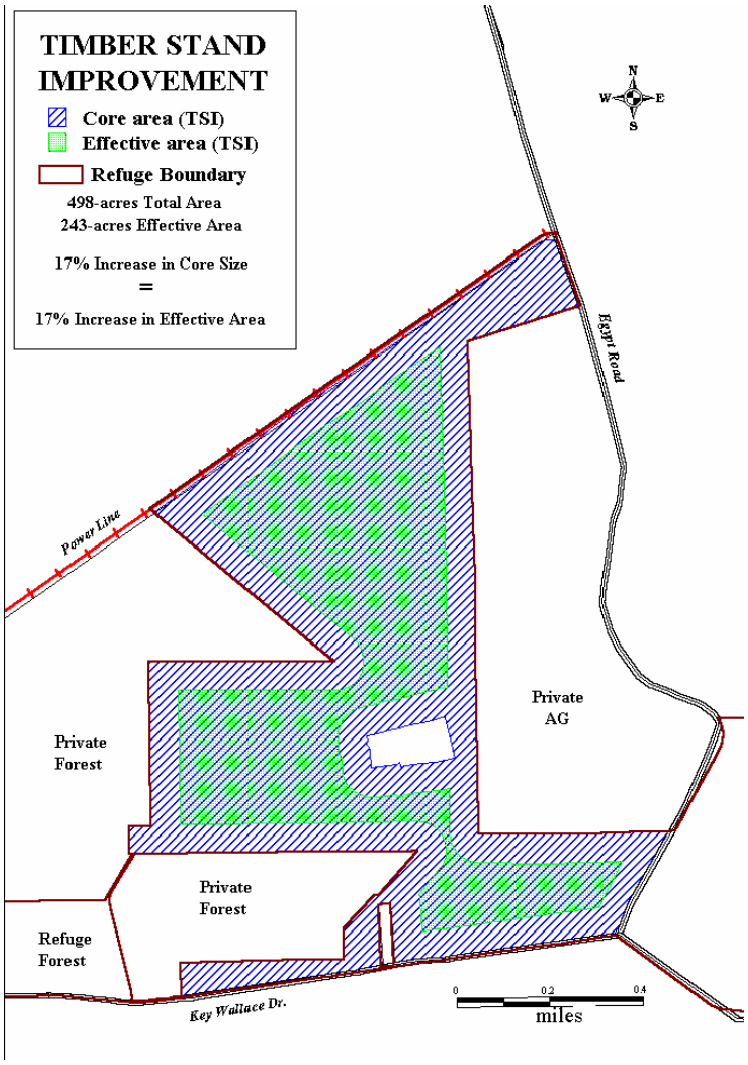

Figure E.12. Core 1 and the consequences of performing TSI and enhancing 71-acres of immature

B.) Core 2

Core 2 comprises 617 contiguous acres of mature forest within compartment M. This assemblage of connected pine, pine/hardwood, and mixed hardwood stands comprises possibly the most diverse assemblage of mature forested habitats on Blackwater refuge (figure E.13). This core is highly variable with respect species composition, age class, and stand conditions. A more detailed description of these forested stands can be found in the Affected Environment Section of Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment and the Forest Management Plan. This core also exhibits some of the greatest potential for expansion through silviculture and land acquisition. However, due to its somewhat linear shape, the current 'effective area' of the core is only 294-acres. The most significant ecological factor which does, and will continue to, detract from this core is the vast areas of salt induced tree mortality. In 1987/88, more than 165 acres of large hardwoods and pines were lost due to storm tides

and prolonged salt water intrusion. The following forest management prescriptions have been determined to be the highest priority for improving the quality of this core. Some of the prescriptions are to be carried out directly within the current core, while, others will be performed in forested habitats adjacent to the core which will eventually improve the integrity of the core. The proposed actions and consequences will be described and geographically displayed.

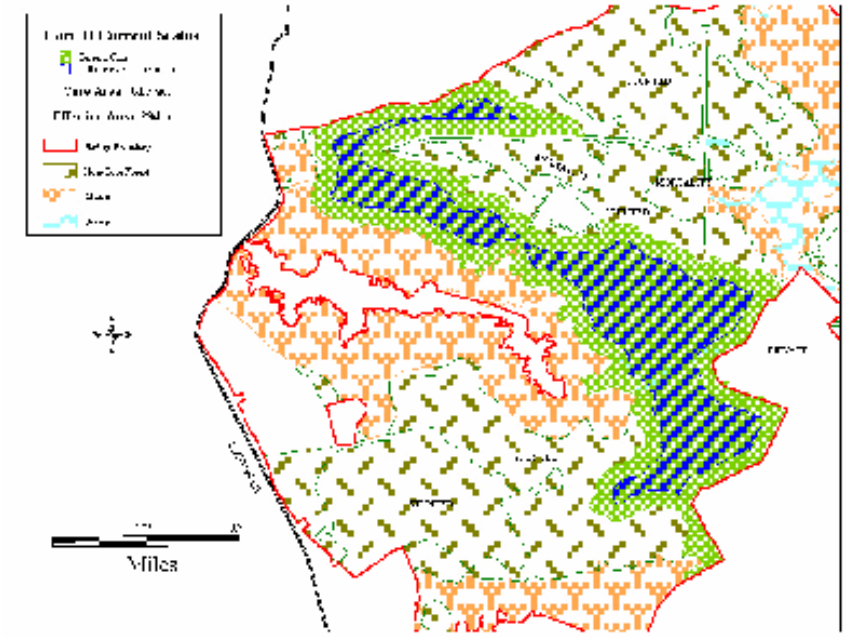

Figure E.13. Core 2

1.) Timber Stand Improvement.
Timber stand improvement is currently proposed on only 120-acres within this core due to the fact that the majority of the stands within the current core are mature to overmature and are more in need of regeneration harvesting than thinning or crop tree release. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

2.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 375-acres of mature and overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

C.) Core 3
Core 3 comprises 864 contiguous acres of mature hardwood dominated forest within compartment U. This expansive tract was previously harvested where the large valuable pines were extracted and the more numerous hardwoods were left. This assemblage of high-graded stands not only turns out to be the largest block of mature hardwoods on the refuge, it is also currently the largest mature forest core with the greatest amount of effective area, 445-acres (figure E.14). In its current state, this core provides potential breeding habitat for 9 of the 11 priority FID species which we are managing for. Much of the remaining pine within the core is becoming over-mature and is of lower quality as a result of being suppressed for most of their lives. The majority of the hardwoods, particularly oaks, are also old and stressed due to the sudden changes brought on by the harvest and subsequent ingrowth of more vigorous hardwoods such as maple and gum. Past gypsy moth infestations have also taken their tole on the oaks in this area. Very little to no regeneration is occurring in many of these stands. The increased amount of sunlight reaching the forest floor following the harvest resulted in extremely dense

understories which preclude natural regeneration and may have negative impacts to DFS populations. The following forest management prescriptions have been determined to be the highest priority for improving the quality of this core. Some of the prescriptions are to be carried out directly within the current core, while others will be performed in forested habitats adjacent to the core which will eventually improve the integrity of the core. The proposed actions and consequences will be described and geographically displayed.

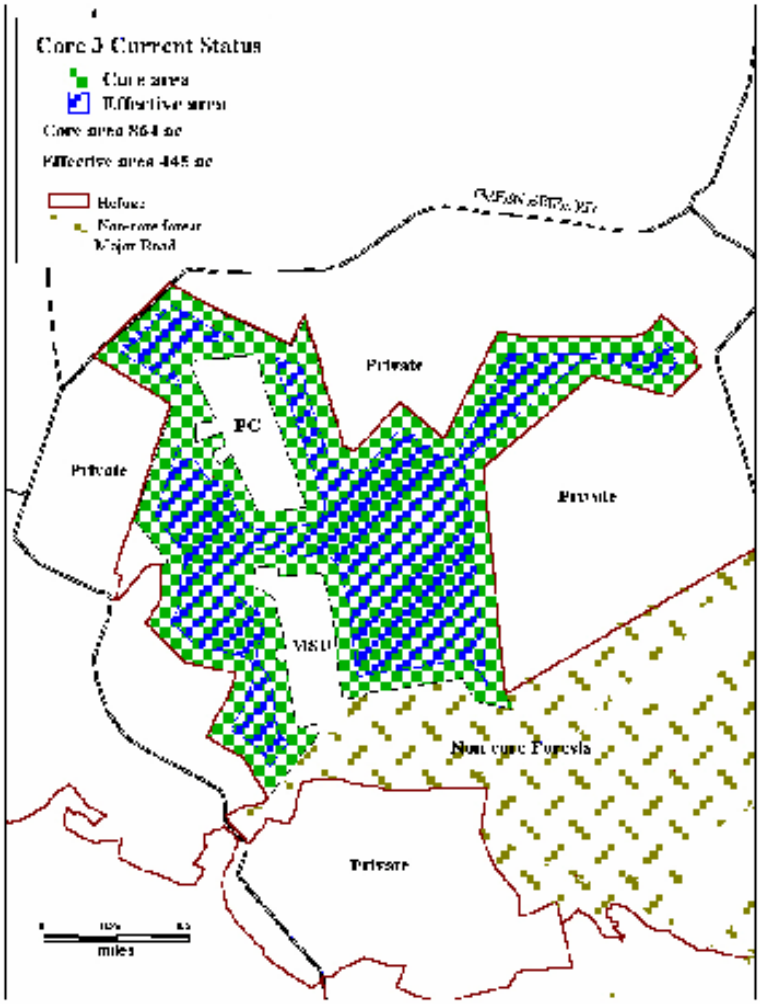

Figure E.14. Core 3

1.) Timber Stand Improvement.
Timber stand improvement is currently proposed on approximately 250-acres within this core. The preferred method of TSI will be crop tree release or a combination of this and one other TSI method. As this core expands as a result of land acquisition, the proposed treatment acres within the core may also increase.

2.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 300-acres of mature and overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

D.) Core 4

Core 4 comprises 722-acres of contiguous mature forests within compartment T. The effective area of core 4 is 355-acres and has a perimeter to area ratio value of 92 (figure E. 15). The current core area consists predominantly of a mixture of pine and hardwood which tapers to a pine dominated forest as it gets lower in elevation and closer to the marsh. A more detailed description of the forests in this compartment can be found in the Affected Environment Section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. The current core size of 722-acres should provide potential breeding habitat for 5 of the 11 area sensitive FIDs.

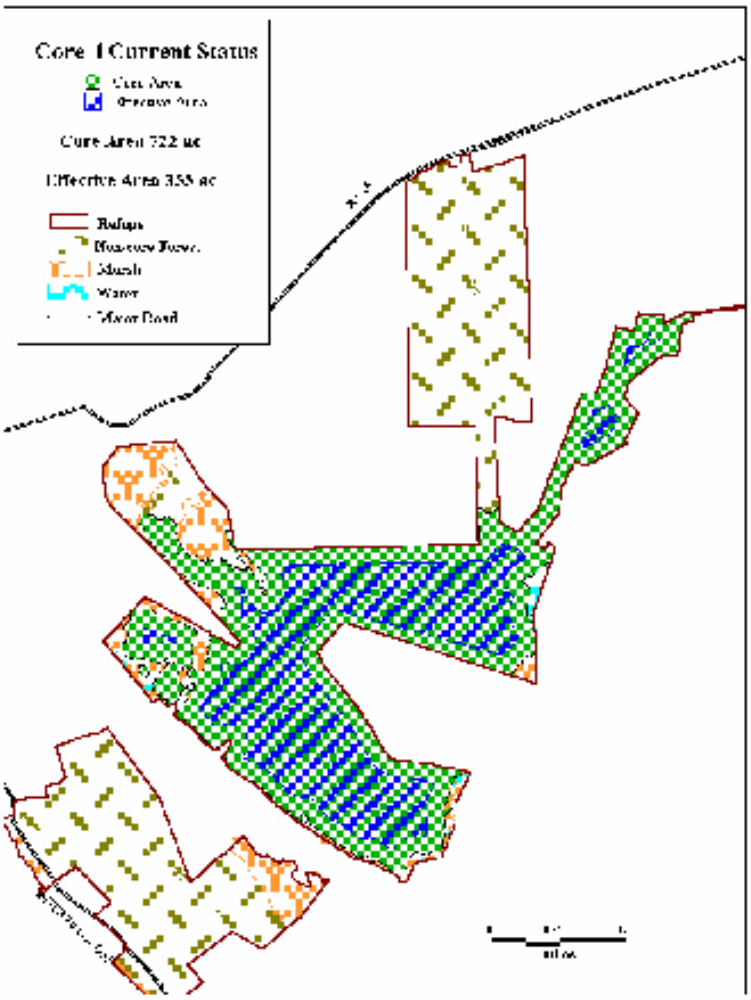

Figure E.15. Core 4

1.) Release Cutting / TSI

Approximately 292-acres of mature loblolly pine timber had been harvested from this compartment prior to acquisition in 1994. The harvest was in the form of a clear-cut, but in areas where the hardwood was denser than pine, the pine was selectively removed and the lower-grade hardwoods were left. Many of these remnant trees were of poor health and form to begin with and continue to show signs of declining health. Although a more detailed stocking inventory needs to be performed, preliminary observations revealed that the majority of this area currently contains an adequate stocking of loblolly pine regeneration. However, the shading from the residual trees has been a significant hindrance to the growth and establishment of a new vigorous stand of trees. Oak regeneration is virtually absent from the stand, most likely due to the dense growth of more

vigorous hardwood vegetation and possibly the lower prevalence of oaks in the original canopy. These factors coupled with the competition from other woody vegetation and the lack of proper management has been a significant setback in the establishment of a new stand. Other areas which served as logging decks during the operations currently contain no regeneration of any tree species. The compaction of the soil and residual debris has precluded the germination of stored or newly fallen seed. The growth and establishment of pine seedlings and saplings is currently hampered by the dense shrub competition and in some areas, shading from residual canopies. Therefore, the regeneration within these stands is in dire need of release. By ensuring the successful regeneration of these stands and their inclusion into the core we will increase the overall size of the core by 292-acres (40%) to 1015-acres. While the effective area will be increased by 173-acres (49%) to 528-acres (figure E.16). The perimeter to area ratio value will subsequently be decreased by 12-percent from 92 to 81. Despite the significant increase in core size as a result of this activity, effective area will still be compromised due to the narrow band of forest which connects these restored lands to the original core. This wooded corridor is bordered by clear-cuts and contains no effective area for FIDs. The total effective area of the newly established core is actually not contiguous and is separated from the original core by this narrow wooded corridor. This factor will only be mitigated through the acquisition and reforestation of the adjacent lands. However, by increasing the overall size of the core to 1015-acres, the new core will potentially provide breeding habitats for all 11 species of the area sensitive FIDs listed.

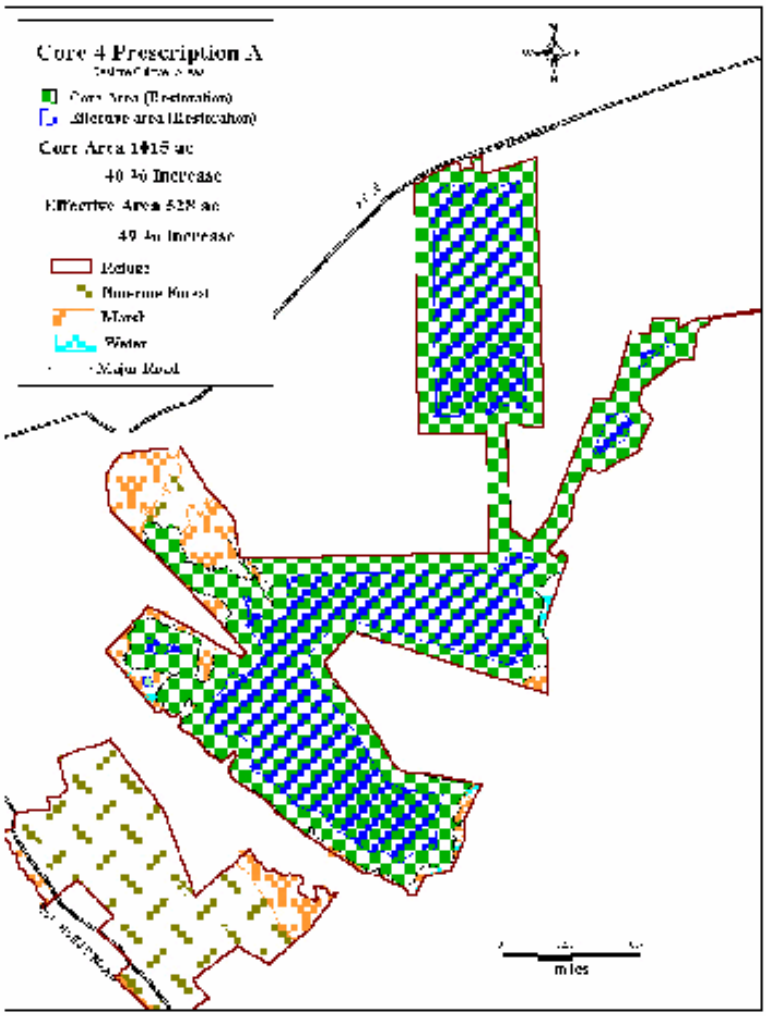

Figure E.16. Core 4 with consequences of performing Release Cut.

2.) Timber Stand Improvement .
Timber stand improvement is currently proposed on approximately 100-acres within this core. The preferred method of TSI will be crop tree release or a combination of this and one other TSI method. As this core expands as a result of land acquisition, the proposed treatment acres within the core may also increase.

3.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy will be performed on approximately 100-acres of mature and overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

E) Core 6
Core 6 is located within compartment R and is currently only 283-acres in size (figure E.17). Due to its linear shape and expansive clear-cut within its boundary, the current effective area for FIDs is only 10-acres. This assemblage of mature forest stands consists primarily of pure pine forests which are located within the 'Critical Areas' and a previously high-graded overmature hardwood dominated stand. The Critical Area can be defined as a zone of protection which may extend out to 1000 feet from the mean high tide delineation along tidal wetlands and waterways. These 'Critical; Areas' are protected and governed through the Maryland Critical Area Act and regulations are enforces by the Critical Ares Commission. Therefore, no management activities will be proposed on forested areas within the designated 'Critical Area'. The only management which will be implemented within the current core boundaries will be a very light selection harvest to promote natural regeneration within this stand. The entire future of this core hinges on the management of the surrounding immature and regenerating stands. The primary management objective will focus on enhancing these adjacent lands to someday include them into the core. The current forest conditions in this compartment are a result of timber harvesting which occurred over a 25-year period. The time factor coupled with the different harvest techniques performed under various site conditions has resulted in a highly diverse forest with respect to age class, species composition and stand conditions. A more detailed description of the forests in this compartment can be found in the Affected Environment Section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment.. In order to perpetuate the growth and development of stands within this compartment for the goal of establishing a core, an equally diverse combination of forest management strategies will be required. The specific commercial management practices which will be performed in the near future are discussed below.

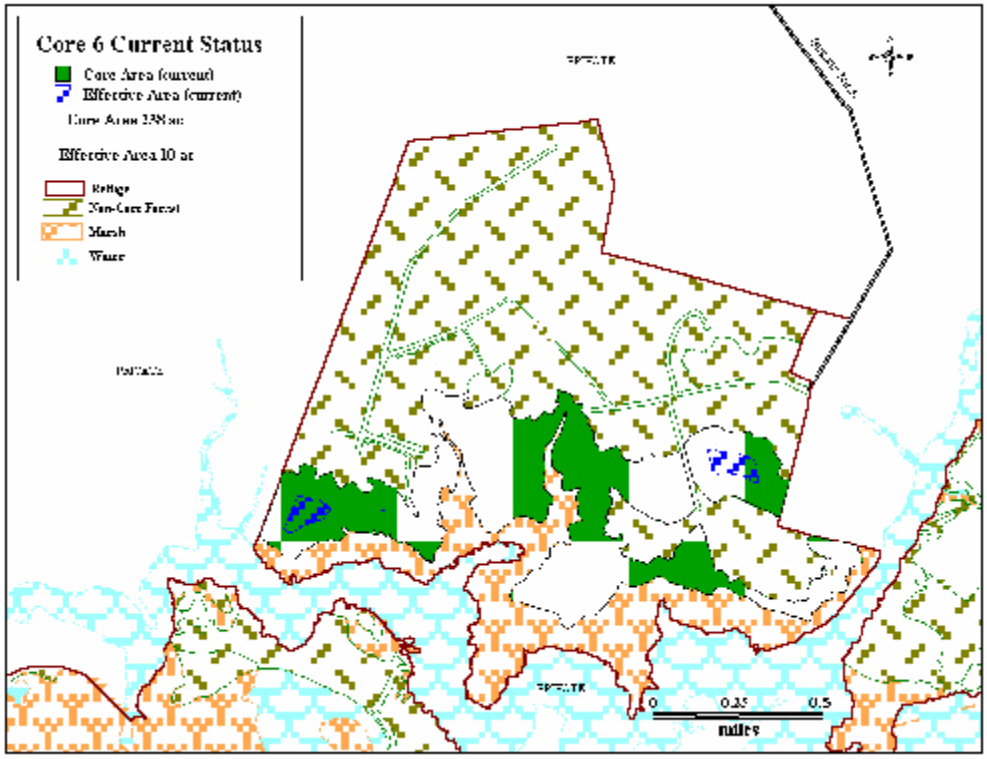

Figure E.17. Core 6

1.) Timber Stand Improvement

Timber stand improvement is currently proposed on approximately 87-acres within this core. It is highly likely that the preferred method of TSI will be a thinning within the 35-40-year-old pure pine stands directly North of and adjacent to the current core. The objective of this thinning will be to reduce the total basal area of the stand to between 80 and 90 square feet per acre, thus enhancing growing conditions for the remaining trees. The long term benefits to the quality of these stands will be most evident at maturity when they will be added to the core. By adding these stands to the core, the overall size of the core will be increased by 31-percent to 370-acres, while, the effective area is increased by 97-acres or 870-percent (figure E.18). Despite the tremendous percentage increase in effective area, the size of the core remains below the minimum size requirements and will provide potential breeding habitat for only 5 out of the 11 highly area sensitive FID species.

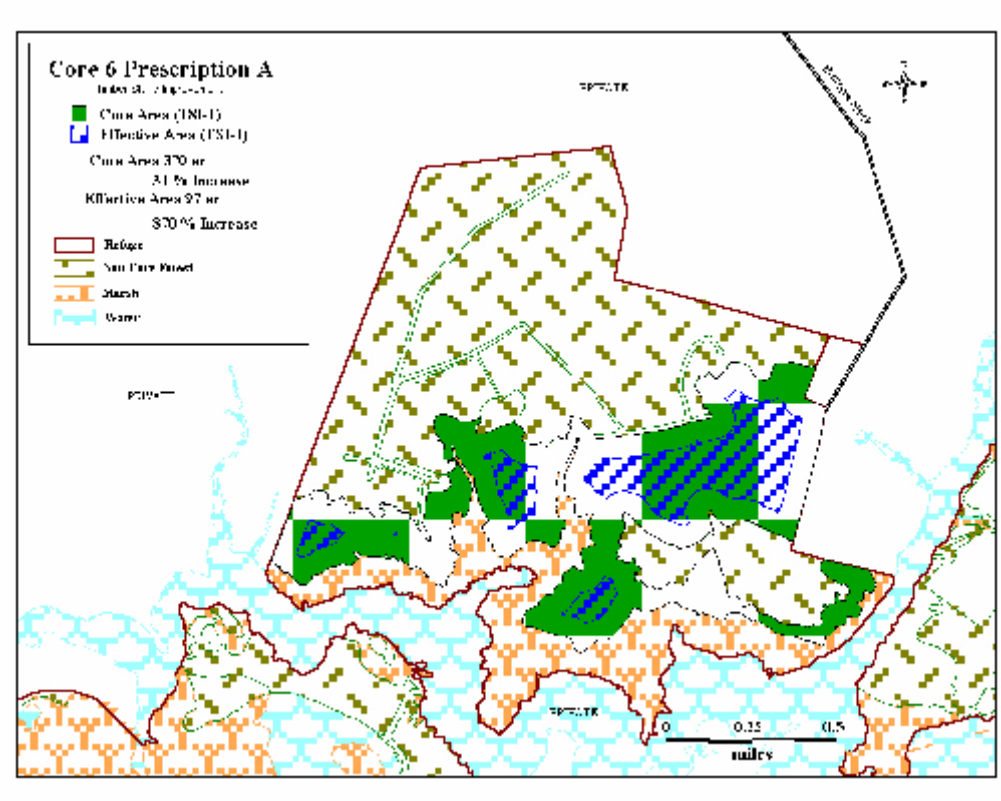

Figure E.18. Core 6 with consequences of TSI.

2.) Release cutting

Approximately 150-acres or more of mature loblolly pine timber was harvested from this compartment prior to and post-acquisition throughout 1994 to 1999. The harvest was in the form of a clear-cut or the selective removal of residual trees left during previous harvest operations. A 66-acre clear-cut is located directly within the current core, therefore regeneration of this stand is a high priority. Although a more detailed stocking inventory needs to be performed, preliminary observations revealed that the majority of this area currently contains an adequate stocking of loblolly pine regeneration. However, dense growth of competing shrubs, vines, and *Phragmites* has significantly impacted the growth and establishment of pine regeneration. Oak regeneration is virtually absent from the stand, most likely due to the dense growth of more vigorous hardwood vegetation and possibly the lower prevalence of oaks in the original canopy. These factors coupled with the competition from other woody vegetation and the lack of proper management have been a significant setback in the establishment of a new stand. Since the original stand was a predominantly pine forest, it will be our intent to manage this area for similar future conditions. If it turns out that loblolly pine stocking levels are more than adequate throughout much of the stand, and oak regeneration is not occurring, management strategies will focus on improving the growth of the existing pine regeneration. As previously stated, the growth and establishment of pine seedlings and saplings are currently hampered by the dense shrub competition and in some areas, shading from residual canopies. Therefore, the regeneration within these stands is in dire need of release. The actual inclusion of these lands to the current core will not take place for another 35-years when the stand has reached maturity. By not managing these areas, we will increase this time frame considerably. The actual impacts of including these areas in the core have been analyzed and illustrated below in figure E.19.

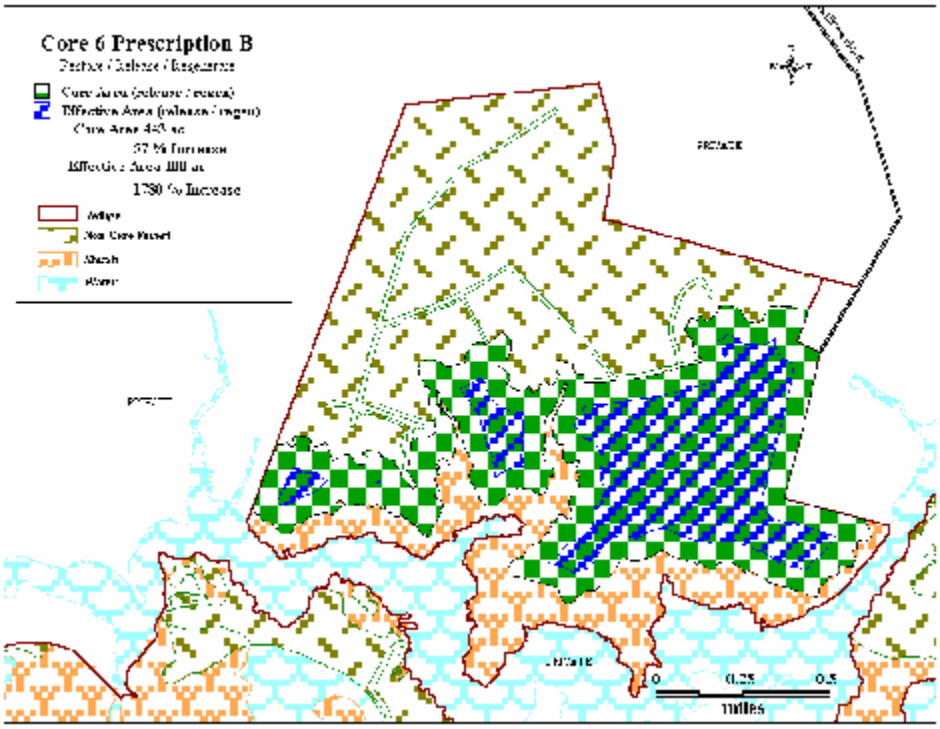

Figure E.19. Core 6 with consequences of Release.

3.) Timber Stand Improvement 2 .

A variety of timber stand improvement techniques will be used within the next 15-years to improve growing conditions for preferred species on approximately 580-acres of previously harvested land. These areas were virtually clear-cut with the exception of some small hardwood dominated pockets which were high-graded. These previously pine dominated areas have since regenerated to a hardwood dominated forest consisting of mostly red maple and sweet gum. Due to the dense and vigorous growth of these early successional species, pine regeneration is sparse and oak regeneration is almost non-existent. The age of the newly established stand is 10 to 15 years. Due to the lack of management during the early stages of stand regeneration, management at this stage will be extremely labor intensive and very expensive. By enhancing conditions of these acres along with the cut-over areas discussed under the previous prescription and ensuring that they eventually become part of the core will significantly increase this core's ability to provide potential breeding habitat for FIDs. By including these areas (in addition to the 87-acres of immature pine stands) we will collectively increase the overall size of the core by 671-acres (237%) to 954-acres. Whereas the effective area will be increased by 642-acres, or an unbelievable 6,420-percent, to 652-acres (figure E.20). The perimeter to area ratio value will subsequently be decreased by 76-percent from 58 to 14. The resulting 954-acre core will provide potential breeding habitats for at least 9 of the 11 area-sensitive FIDs listed.

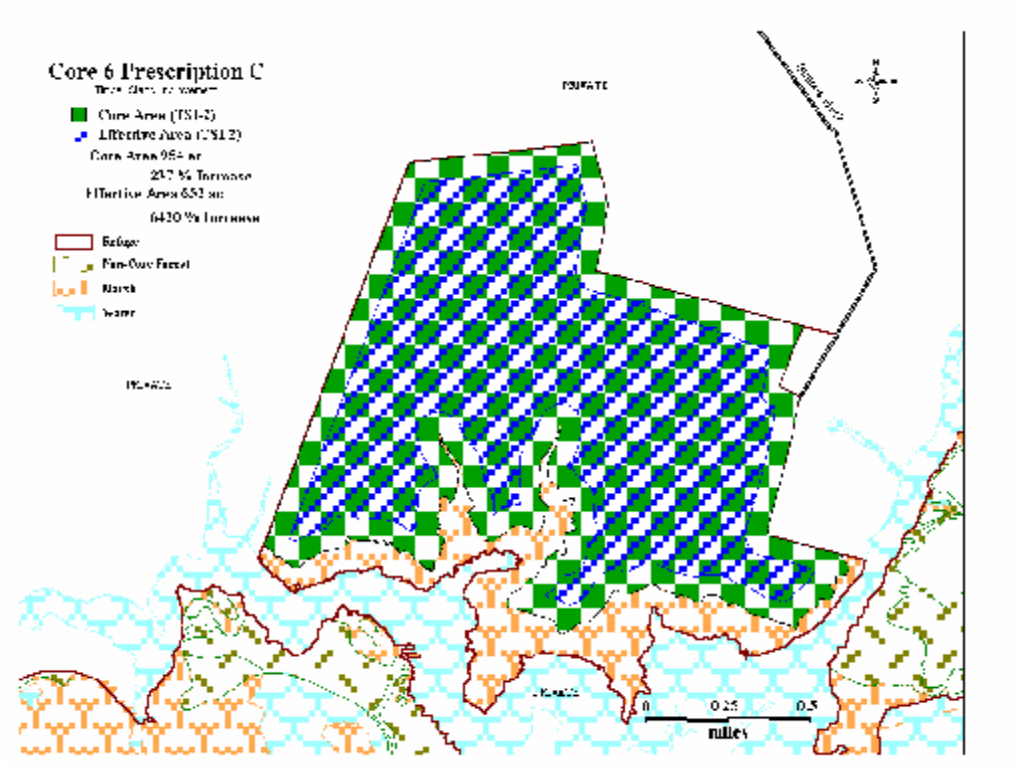

Figure E.20. Core 6 with consequences of TSI 2.

4.) Regeneration Harvests
Techniques to enhance the natural regeneration of both hardwood and pine species under the mature canopy of high graded stands may be performed on approximately 58-acres of overmature forested habitat within this core over the next 15-years. As this core expands as a result of land acquisition, the proposed treatment acres may also increase.

The management prescriptions which will be proposed on non-core forest habitats are of somewhat less significance and will not be described in as great a detail. Additional forest management will continue to be performed within the current refuge boundary as well as newly acquired lands, however many of these specific management needs cannot be projected at this time without additional inventories and data collection. Future and ongoing management of the forest habitats will be driven by the same management goals and objectives which led us to the development of the following management strategies.

(C) When would the use be conducted?
To assist in the determination of management needs, it is imperative that a continuous inventory and monitoring program be implemented throughout the refuge to evaluate forest conditions. Once management recommendations are made, any of the previously mentioned strategies may be utilized to achieve the desired results. With the limited amount of data pertaining to specific forest stands and their condition, it is impossible to make management prescriptions for all forest lands on the refuge for a 15-year period. Therefore, all of the management recommendations are based on current knowledge of stand conditions for those areas. As more information is gathered, we will develop more management prescriptions and at the same time the priority of new and existing prescriptions may change. The above mentioned prescriptions only include those which are currently of highest priority. The prioritization of silvilcultural prescriptions and subsequently, commercial timber harvesting, is subject to change due to factors such as acquisition of new lands, insect, disease or storm damage or availability of funding. Generally, Commercial Timber Stand Improvements will be performed within immature stands less than 40

years of age which are characterized as having very high stand densities, undesirable species composition or undesirable species dominance (e.g. oaks being suppressed by gum and maple). Commercial regeneration cuts will generally be performed in overmature stands (80 to 100 plus years old for loblolly pine) which exhibit significant decreases in annual growth and/or are showing signs of heart rot or other diseases. The types of commercial harvests performed will be those which maximize the potential for natural regeneration of the stand and do not focus on the quality or quantity of saw timber removed. Stands will be harvested during a period when disturbance to the soil will be at a minimum yet also allow for the maximum seed germination and ultimate regeneration. Timber harvests will not be performed during the primary breeding season for Delmarva Fox Squirrels and Bald Eagles (if nests are within or directly adjacent to harvest area). Timber harvest will also be limited but not prohibited during the breeding season for FIDs which occurs during the Months of April through August. Since this period also includes some of the best months to perform mechanical forest management activities as dictated by soil and hydrological conditions it will be impossible to completely avoid performing commercial timber harvest during FIDs breeding season. Due to the traditionally wet winters and springs the majority of forest management practices will be performed during the months of July through December. Performing commercial timber harvests within existing cores will be significantly more restrictive.

(D) How would the use be conducted?
Forest stands subject to commercial silvicultural prescriptions will first be inventoried to collect the appropriate data relative to the type of activity being prescribed. For example; for stands slated for TSI, data such as basal area, trees per acres, age, and species composition would be vital to justifying and monitoring the action. Whereas, variables such as age, species composition, basal area, trees per acre and volume of forest product in the whole stand, as well as that which will be harvested, will be collected prior to performing any harvest. The procedure for conducting pre-commercial and commercial Timber Stand Improvements on the refuge will be heavily influenced by the availability of funds (primarily for pre-commercial) and the current market status for the types of forest products produced as a result of the activity (e.g. poles, pulpwood, chips or firewood). For these harvests, a desired future condition will be specified by the refuge forester. This information, along with all other job specifications, will be provided in a special use permit (which is the accepted form of contact for performing timber harvests on National Wildlife Refuges). A copy of the permit or statement of work will then be sent out to local and regional timber harvesting companies. Contracts will either be awarded to the highest bidder (if the stand and market allow for the sale of yielded products).

As for harvest which result in the removal of saw timber, a more formal approach will need to be taken. Once again the proposed stand will be inventoried to acquire essential data (specifically overall merchantable volume). This data will also be provided in a special use permit along with a statement of work including all of the particulars and stipulations which must be adhered to. This will then be sent to local and region potential contractors inviting them to visit the proposed harvest site and perform their own inventories and subsequently submit sealed bids for the forest products expected to be harvested.

(E) Why is the use being proposed?
The primary focus of management prescriptions will be toward the establishment, protection and enhancement of the 'core management areas' for their benefits as habitat for DFS, bald eagles and FIDS. Through silvicultural practices, the desired future conditions will be a more healthy forested ecosystem with a guarantee that a minimum of seven mature forest cores will be maintained at an optimum size, effective area, perimeter to area ratio, species composition and overall health by the year 2015. A detailed description for each of the established and potential cores within the current refuge boundary and the proposed prescriptions and resulting future conditions are discussed below along with additional high priority management recommendation for non-core habitats. These specific management prescriptions represent only the highest priority management needs. The forest management on BNWR will not be limited to these high priority areas (cores). Instead it will focus on utilizing the previously described silvicultural techniques to enhance the overall quality of forest habitats throughout BNWR. All additional prescriptions or management recommendations can be collectively grouped under the umbrella of

conducting forest management for the improvement, maintenance and perpetuation of healthy and diverse assemblages of both contiguous and disjunct forested habitats in order to achieve refuge forest management goals and objectives.

In addition, as previously mentioned, commercial management practices are the preferred method over using force account due to the fact that the refuge system does not own the equipment necessary to perform the tasks properly without causing significant negative impacts to the sites. Nor does the Refuge have the manpower to either run equipment or harvest trees using chainsaws. Commercial timber management is the most economical, safe and environmentally sound method of achieving many of our proposed forest management objectives. It is also imperative that fund generated from the sale of forest products be returned to the refuge in order to ensure proper restoration of the forest and help support the management and/or restoration of additional forest habitats since there is no actual funding provided from the Service to support forest management activities on refuges.

1.) Commercial Timber Stand Improvements

Commercial Timber Stand Improvements (TSI) which includes, but are not limited to crop tree release, thinning and improvement cutting may be performed on as much as 2800-acres of immature and mature stands on Blackwater Refuge and the Nanticoke Division which are stressed due to overcrowding and competition for resources. These intermediate cuttings will result in improving the growth of an existing crop of trees, but will not result in stand replacement. The selective removal of less preferred, overstocked, intermediated and co-dominant vegetation will allow the expansion of the crowns and root systems of remaining trees. The vacancies created in the growing space will not be large or permanent enough to allow height growth of any new trees that become established as a result of the treatments. When a forest is young, it always contains many more trees than it will when it is mature. One thousand or more young saplings may initially compete for a foothold on a single acre of land. Fifty years later that same 1-acre of land will only support a few hundred trees. Performing ***thinnings*** of various types in overstocked stands will free up nutrients and other resources and promote faster growth rates, greater mast production and healthier trees. Thinning overcrowded stands will significantly reduce competition and decrease stress. In a crowded forest, trees tend to grow very tall due to competition with its neighbor for sunlight. Tall trees in a crowded forest usually have very thin trunks. All new growth goes toward obtaining height, not girth. While crowded trees are constantly competing with each other, they also depend on each other for support. Tall, thin trees cannot support the weight of their own branches by themselves. The interwoven branches of crowded trees provide support for one another. Openings which naturally occur in a forest due to one or more trees falling will result in several thin-trunked trees losing their support. In an opening, a thin-trunked tree will suddenly find itself being buffeted by the wind, causing the trunk to sway. In response to the bending, the tree will add wood to its stem to stabilize itself. Growth hormones allow the tree to direct the growth to the stem when environmental conditions require it. The fact that trees can concentrate growth in a specific region of the tree in response to external environmental conditions is valuable knowledge to a forest manager. By thinning forests, we as land managers mimic nature by following the process of natural selection. By cutting out the weak, crooked, and over-crowded trees, the strongest trees can reach their fullest potential. A thinned forest is typically healthier than a crowded forest. Once thinned, the remaining trees will expend less energy competing with other trees which will enhance their ability to fight off invasions of insects or disease. The trees that remain after a thinning will grow sturdy, thick trunks and few will be lost to windfall.

Wildlife will benefit from these thinnings due to both the increased growth and mast production as well as the abundance of new food available on the forest floor. Most of the plants used by wildlife for food grow on the forest floor and require sunlight (Jastrzembski, 2000). Thinning forest stands will temporarily increase the amount of sunlight hitting the forest floor which will allow for the germination of many new plants. The resulting plant diversity in the understory is especially aesthetically pleasing to hikers, hunters, and photographers. When properly performed, thinnings will benefit the entire forest ecosystem and enhance the many values we receive from our forests. Thinning will also help to

reduce the risk of oak decline by reducing competition for moisture and nutrients and promote better physiological condition of the remaining trees. Silvicultural practices designed to encourage species best adapted to the site can help reduce the effects of drought or frost. Removal of weak and dying trees may also reduce or delay buildups of two-lined chestnut borers.

Release cuttings (crop tree release) will result directly in increased growth rates and mast production and may also be used to regulate or modify species composition in a young stand. Precommercial crop tree releases will increase tree diameters and help ensure survival. Released trees will become mature sooner and/or attain a larger size at maturity. Crop tree selection efforts will always focus on healthy trees with well-formed crowns and should include species from both the red and white oak groups along with beech and pine. The crop tree species diversity will promote a more consistent mast crop (Whiteman and Onken, 1994). Crop tree selection will also focus on mast production, providing dens and timber quality. Crop tree release will consist of cutting only trees that are directly competing with crop trees. The process will not consist of selecting crop trees and cutting all other trees in the stand. Therefore, an acceptable level of species diversity and richness will be maintained. Mast producing hardwoods, when released, will be able to respond by increasing both height and diameter growth and most importantly crown diameters. Hardwood mast production can be maximized and a sparse understory can be maintained by promoting large crown development of mast producers in the overstory. Mast production in immature stands (average dbh < 12inches) is likely to be very limited. Although these stands can have an open understory, they typically are overcrowded and as a result have smaller crowns. A 12-inch dbh tree will generally produce 225 percent more mast than it did when it had a 10-inch dbh. Generally mast production increases with the diameter of the tree until it reaches 22-24 inches dbh, at which time mast production starts to decline as the tree becomes over-mature. The rate at which immature stands reach the desired conditions for DFS can be expedited by identifying potential hard and soft mast crop trees and performing a release cutting around these trees to encourage crown development (Onken and Whiteman, 1994).

Loblolly pines that have developed in a suppressed condition respond in varying degrees to release. Increases in diameter growth after release are related to live-crown ratio and crown growing space. Trees of large diameters generally respond less than trees of small diameters. Trees with well-developed crowns will usually respond best to release. Trees long suppressed may grow much faster in both height and diameter after release but may never attain the growth rate of trees that were never suppressed (Baker and Langdon, 1990).

Once again, the majority of these practices will be performed on a commercial basis whenever possible due to the specific nature of the types of equipment needed to perform the task properly. The Service simply does not have the equipment or personnel necessary to achieve the desired results economically with the least environmental impacts.

2.) Commercial Stand Replacement / Regeneration Harvests.
In order to ensure the long term existence of core areas, stand replacement or regeneration must be an ongoing management objective. A common characteristic of mature and overmature forest stands on Blackwater is generally a closed canopy and, as a result, a sparse understory. Also due to the closed canopy and lack of sunlight, there exists little or no natural regeneration of preferred tree species such as oak. Techniques to enhance the natural regeneration of both hardwood and pine species under a mature canopy may be employed on as much as 2033-acres of mature and overmature forested areas on Blackwater Refuge over the next 15-years. Harvesting methods which are performed for the purpose of stimulating the germination of stored seeds or sprouting of root stocks and eventual stand replacement include, but are not limited to, single tree selection, group selection, shelterwood, and strip and patch clearcuts. The most frequently utilized methods would be single tree selection and shelterwood techniques due to the minimal impacts to the forest canopy and the lesser effects on the integrity of the cores. Performing these prescriptions would have no direct impacts on the size, effective area or perimeter to area ratio of the core. Additional techniques such as group selection, strip and patch cuts

and seed tree harvests would only be utilized when it has been determined that they are the only or best option for regenerating an over-mature or unhealthy stand. Within core areas, these methods will only be performed when lands of equal or greater quality in terms of acres, age and species composition can be added to the core to offset the temporary impacts to the size and perimeter to area ratio of the core. A minimum post-harvest basal area will be the target when preparing prescriptions for these areas. Performing regeneration harvests in some of the mature and over-mature stands throughout the complex will reduce the potential for forested habitats to become stagnant. As trees become over-mature and reach the end of their life, as is the case with many pines in these stands, their growth rates slow considerably and mast or seed production is severely reduced. The selective removal of dominant and co-dominant canopy trees which showing signs of declining health will allow necessary light to reach the forest floor to facilitate seed gemination and free up additional resources to enhance the growth of new regeneration. In most cases the resulting natural regeneration will likely be dominated by pine, red maple, sweet gum and possibly beech. Due to the many complications related to the germination of oak seeds such as parasitism, predation and other various site conditions, it is likely that oak regeneration will be minimal. The planting of oak or other hard mast producing species may be required in these openings in order to ensure their replacement and continued occupancy of the stand. Additional future silvicutural treatments may be required to ensure survival and optimum growth of new trees, thus increasing their chances of achieving dominance in the stand. Creating openings in the canopy will not only enhance natural regeneration but will also enhance growth and mast production of remaining trees, much like a crop tree release. The perpetuation of the stand through promoting regeneration and the associated improvements in mast production will have significant long-term benefits for DFS. Future implementation of TSI techniques will ensure that the species composition of these stands is not significantly altered.

Availability of Resources:
The Proposed Preferred Alternative in the Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex recommends one supervisory forester, one field forester and two forest technicians to adequately achieve the proposed forest management objectives for Blackwater and the Nanticoke Division.

The current staff of only one permanent forester is far from the minimum staff needed to implement such a large and complex forest management plan. Money generated from the sale of forest products will be deposited in the 'expense of sales' account under the code 6860 for distribution back into the refuge system. It is expected that a significant percentage of the funds generated by the sale of timber on Blackwater NWR will be returned to the refuge the following year for the purpose of supporting and sustaining the forest the refuge's forest management program, and performing activities such as regeneration and restoration, follow-up inventories, additional stand inventories, timber marking and any related road work.

When appropriate and applicable, tasks such as forest regeneration and road rehabilitation may be included in the contract as an end product and will be included as part of the bid. This would alleviate any additional management costs to the government associated with this specific activity. However it would not eliminate the majority of preliminary site preparation and some minor road maintenance.

Also when appropriate and available, the reforestation of the site will be performed through partnerships, grants and volunteers which will also result in no significant costs to the government.

It is anticipated that all harvesting will be performed near or from existing roads. Since we would not be constructing any new facilities or improvements on refuge property for this specific use, there would be no significant construction costs associated with this use. However, funding for the maintenance of roads and water control structures will be necessary.
Contract development & administration and monitoring costs associated with maintaining statistical information on timber harvesting activities will be assumed refuge forestry staff.

Cost Breakdown:
The following is the list of costs to the Refuge required to administer and manage the proposed commercial forest management practices on an annual basis.

Refuge Personnel Costs
Forest Inventories (50 days @ 8 hrs/day@$25/hr.).....$10,000
Marking Timber (45 days @ 8hrs/day@$25/hr.)..... $ 9,000
Contact Development (28 days @ 4hrs/day@$25/hr.).....$ 2,800
Contract administration (30 days @ 4 hrs/day@25/hr.).....$ 3,000

Total..... $24,800

Anticipated Impacts on Refuge Purpose(s):
All anticipated and potential environmental, socioeconomic, and cultural/historical impacts resulting from the above mentioned activities can be found in the ' Consequences' Section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. The consequenses specific to forest management activities can be found on pages 4-42 through 4-110 of the CCP's Environmental Assessment.

Public Review and Comment:
This compatibility determination will be submitted for public review and comment as an appendices to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
All commercial forest management activities will be performed in accordance with recommendations and guidelines described in Both the Endangered Species Recovery Plan for the Delmarva fox Squirrel and the"Management Guidelines for Bald Eagles in the Chesapeake. Below is a list of additional stipulations which apply to the overall forest management program and will be followed when carrying out all forest management activities.

- Forestry management decisions will be based upon the best available dendrological and biological information.

- Forestry management objectives and strategies will focus on conservation of entire communities of native wildlife and plants to contribute to the biological integrity of the ecosystem and purposes of the refuge as appropriate at the local, regional, and landscape level.

- Forestry prescriptions will have a landscape context, consistent with the mission of the Refuge System and individual refuge purpose and will explicitly link to national, regional, and eco-regional wildlife management objectives.

- Forestry prescriptions will attempt to restore or mimic natural regimes and processes to achieve habitat objectives by recreating and/or maintaining a desired forest condition for Service trust resources as required by the Integrity Policy.

- Forestry management actions will eliminate, reduce, or create unfavorable conditions for exotic and invasive species.

- Each forest community objective will include monitoring protocol(s) and use the process of adaptive management to assess and modify management strategies to achieve objectives.

- Biological goals will be established for each forest each management unit. Biological goals may include elements from the following: ecosystem processes, wildlife-habitat relationships, hydrology, connectivity, viability of special species, and/or hydrogeomorphic processes.

- The Forestry Management Program will have restoration objectives, where appropriate, to guide the desired future forest conditions.

- The overarching management philosophy/objective is to create a forest management program that improves ecosystem health and conserves biodiversity which simultaneously contributes to the forestry industry and local economy of the Eastern Shore.

- Forest management practices will focus on improving forest health, increasing tree growth and vigor, reducing stress, increasing hard and soft mast production, promoting desirable species composition and facilitating the natural regeneration of desirable tree species throughout the refuge on appropriate sites.

- Desired future conditions of the station's forests will be managed to enhance ecological and structural diversity where feasible and prudent by using a variety of silvicultural techniques and by retaining a diversity of vegetation and unique structural features.

- Best Management Practices will be employed that meet or exceed state and federal standards for the protection of endangered species, forest interior dwelling species of neotropical migratory songbirds, water quality, wetlands, and other aquatic resources, including the retention of forested buffers.

- Silvicultural treatments will ensure that air quality will not be degraded by burning only when prescribed burning is an appropriate silvicultural technique for the improvement of forest conditions or aesthetics in visually sensitive areas or when required by law for hazard abatement.

- Management actions will ensure future forest growth and sustainable productivity by reforesting all harvested areas in a timely manner consistent with ecological conditions.

- Silvicultural forestry management will maintain soil and site productivity by minimizing soil disturbance and by recycling harvest residues for soil nutrient enhancement.

- Under a landscape-level lense, the forestry plan will conserve fish and wildlife resources through targeted research and management of the habitat/wildlife relationships, retention of late successional areas, judicious control of road access, timber harvest management and cooperation with state and federal fish and wildlife agencies.

- The Forestry Management Program shall have visual quality objectives, recognizing and managing for aesthetic values near communities and major travel corridors by using appropriate design standards and harvest methods.

- The Plan shall cooperate with adjacent landowners to address and minimize potential impact of forest management activities.

- Implementation of the Plan shall have features which will ensure the application of new scientific, social and economic information to improve silvicultural and management practices and enhance environmental and financial performance.

- During any forest management practice, all den and cavity trees will be retained and protected from damage to the best of our ability.

- During any silvicultural treatment, neither DFS den trees nor adjacent trees should be cut. The foliage of adjacent trees shades the bole of the den tree, thus keeping the den cooler. In order to promote additional den sites, trees interfering with crop tree crown development should not be felled, but rather left standing and killed by girdling or by using systemic herbicides.

The following recommendations that apply to commercial timber harvesting are from the FIDS/Forestry Task Force Chesapeake Bay Critical Area Timber Harvest Plan Guidelines (June 1999). We will make every effort to adhere to these when applicable and appropriate to achieving management objectives.

- Reforest existing openings in forest tracts, especially those located in forest interior areas.
- Reforest existing nonforested areas along the edge of a forest tract. Select areas which maximize the forest area: edge ratio and total forest tract size.
- Allow existing woods roads to reforest or reduce their width so that canopy closure is maintained over the road.
- Establish a core area where little or no harvesting occurs; select areas at least 5 acres in size and locate them, if possible, in the most interior part of the forest and adjacent to other areas with little or no harvesting (*e.g.*, Critical Area Buffer, steep slopes).
- Retain a no-cut buffer of at least 100' along each side of of perennial streams, rivers and extensive forested wetlands (corridors will be maintained out to 300').
- Increase the width of riparian forest corridors to at least 300' and, ideally, to > 600'.
- Conversion of riparian hardwood or mixed hardwood-pine forest on perennial streams to loblolly pine is not permitted.
- Conversion to pine forest (*i.e.*, forests in which loblolly pine comprises > 60% of the total basal area) is acceptable in isolated, small forest tracts (<100 acres) lacking mature mixed hardwood-pine stands; within 300' of existing permanent forest edges; adjacent to existing loblolly pine stands, and in narrow (<600' wide) forest peninsulas that extend out into a nonforested area. In all cases, some hardwoods would be retained in understory, midcanopy and overstory.
- Maximize pole stage or older.
- Retain >8 snags per acre that are > 8"dbh
- Retain dead and downed wood debris on forest floor during harvest operations.
- Single tree selection will be the preferred harvest strategy in the interior.
- Timber harvesting (not TSI) will be avoided in 'Core Areas' during 1 April - 1 September, which is the breeding season for most FIDS.

Justification:
The justification for performing silvilcultural prescriptions such as commercial timber harvesting is described in great detail throughout both the Alternatives section and Consequences section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex Comprehensive Conservation Plan of which this document is an attachment, as well as in the Forest Management Plan for Blackwater NWR.

The overall impact of performing timber harvest on Blackwater NWR and the proposed Nanticoke Division will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the Refuge was established. Also, in accordance with 50 CFR 29.1, the commercial harvesting of timber, as an economic use, will contribute to the administration of Blackwater NWR and the mission, purposes, goals, and objectives of both the Refuge and the NWRS. Through authorized commercial

and force account silvicultural practices, the desired future conditions will be a more healthy forested ecosystem with a guarantee that a minimum of seven mature forest cores will be maintained at the optimum size, effective area, perimeter to area ratio, species composition and overall health by the year 2015 to achieve our wildlife management goals and objectives. As previously mentioned, commercial management practices are the preferred method due to the fact that the refuge system does not own the equipment necessary to perform the tasks properly without causing significant negative impacts to the sites. Nor does the Refuge have the necessary manpower to effectively accomplish timber removal. Commercial timber management is the most economical, safe, and environmentally sound method of achieving many of our proposed forest management objectives.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 10 year Reevaluation Date: June 26, 2016

Attachments:

None

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COMPATIBILITY DETERMINATION

Use: Trapping- Furbearer Management

Station Name: Blackwater National Wildlife Refuge

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table I summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):

For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."

For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."

For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other

fish and wildlife in North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:
"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of furbearer management programs with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is furbearer management to authorize the take of muskrats and nutria and the incidental take of red fox, raccoon, skunk, opossum, and gray fox.

Background and Rationale for the Management Activity
When the refuge was surveyed prior to acquisition in 1933, it was noted that the production of furbearers in the Blackwater area, primarily muskrats were unsurpassed on the East Coast. The original acquisition of approx. 8,000 acres was from an investment partnership, "Delmarvia Fur Farms," which hired a number of local trappers to harvest muskrats and other furbearers during the winter months. After acquisition in 1933, "Delmarvia Fur Farms" continued to lease the land for several years. In 1935, a total of 38,000 muskrats were harvested from the property. After the lease arrangement had expired, the refuge continued to utilize local trappers to harvest muskrats and partnered with these trappers in marketing pelts to commercial fur buyers. The refuge utilized trapping as a method to control furbearer populations and protect the marsh vegetation from destruction which occurs when herbivore populations are not maintained. Significant areas of marsh loss occurred on the refuge marshes when extremely high muskrat populations occurred in the late 1930's. Trapping was also utilized to control predator populations (fox, raccoons, skunk, and opossums) which was consistent with current policy at that time for increasing waterfowl populations. In the early 1970's, refuge trapping leases were selected by lottery and 3 trappers were selected for 3 year contracts. This process later evolved to public bidding for annual leases of 10-17 trapping units which were drawn utilizing natural features as boundaries.

The current program is similar today, and allows for the taking of muskrat, nutria, raccoon, fox, skunk, and opossum during the period of January 1 thru March 15 consistent with Maryland seasons. Surveys are conducted prior to the season to determine population levels, and furbearer management recommendations are submitted as required by policy.

This program has been historically dependent upon the international fur markets as to the interest and funds it is capable of generating. When markets were strong in the early 1970's, the refuge received in excess of $15,000 in annual bids and 30+ bidders competed for 10-15 trapping units. As the markets diminished due to the unpopularity of wearing furs in the late 1970's and 80's, interest in the program also declined. Currently the refuge has a cadre of 10-15 local trappers which bid $2,000-4,000 annually for trapping rights.

Management of nutria populations, which were introduced to the area in the 1930's and 1950's, has also been impacted greatly by this market driven program. When fur markets were high and nutria pelts generated $5+, refuge trappers contributed greatly to curbing this destructive rodent's impact on refuge marshes. However, when markets crashed and nutria trapping was not economically feasible for refuge trappers to continue the level of control required to control populations, Blackwater instituted the first of its kind trapping rebate program which offered refuge trappers $1.50 in return for each nutria harvested up to the amount of the trappers' bid price. Over 53,000 nutria have been harvested by refuge trappers under this rebate program since 1991.

(B) Where would the use be conducted?
Furbearer management activities will be conducted primarily in refuge marshlands, with no-trapping restrictions around eagle nests, roads, public use areas, and other sensitive sites. The main emphasis will be on trapping muskrats and nutria. There will be some incidental take of raccoons, opossums, and red foxes. Some upland activities may be permitted but will be restricted by methods and access due to conflicts with endangered species, waterfowl use, and public use activities. Population levels will determine annual use of areas, and rotational trapping may be utilized if populations do not warrant trapping on an annual basis.

(C) When would the use be conducted?
Furbearer management activities will always occur during the framework of the Maryland trapping season of December 15 thru March 15. Normally, trapping will occur between the dates of January 1 and March 15 due to conflicts with other management programs.

(D) How would the use be conducted?
After population surveys are conducted and annual furbearer management programs are approved, refuge regulations and seasons will be developed and publicly announced. A news release will announce the opening of refuge trapping units for public bidding. Trapping units will be opened for inspection during set dates, and an annual public meeting will be scheduled to review regulations and restrictions for that year. A public bid opening will be scheduled where bids are opened and the highest bids are selected under policies currently established. Once prospective trappers have paid their bid amount, a special use permit will be issued which notes restrictions and uses permitted. Trappers will be permitted to access areas at designated locations and authorized trapping activities will be permitted. These uses may be altered under special circumstances, and all trapping activities and equipment must cease and be removed from the refuge by designated dates on the special use permit. A harvest report will be mailed to the participants. The report must be completed and returned by a set date or the user will forfeit his/her opportunity to participate in the program the following year.

(E) Why is the use being proposed?
Furbearer management (trapping) is a bonafide management activity which has been used historically to manage and control furbearer populations. This highly regulated effort accomplishes these management goals to maintain populations consistent with the carrying capacity of their habitats with a minimum of cost. Herbivore populations naturally experience peaks and valleys of population levels. Refuge marshlands are documented to be currently stressed by rising sea levels, increased salinity, and land subsidence. It has been noted that further impacts from excessive herbivory causes permanent vegetation loss. The Refuge and the Corps of Engineers are undertaking a major marsh restoration effort in the Blackwater marshes. It is imperative that furbearer populations remain under control to facilitate that effort. This program will also facilitate the current efforts to control the nutria population which is ongoing by the MD DNR, Blackwater NWR, and the USDA.

The furbearer management program has historically provided an economic benefit to members of the local community. Trappers are generally watermen and/or farmers who are unemployed during the late winter months. Currently, the income levels generated are at a all time low, and thus minimal interest in this program exists except in a hard core cadre of local trappers. Culturally, we would like to preserve this local occupation.

Availability of Resources:
The Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex recommends two full-time law enforcement officers (one at Blackwater and one for the Nanticoke Division) to conduct this and other hunting/trapping programs. One full-time officer was hired in FY2003. Combined with the existing two collateral duty refuge officers, there will be sufficient personnel to ensure compliance with regulation, protection of the resources, and public safety when all these positions are filled.

There will be no major management actions required for this program. Population surveys will be conducted. This typically will take 2-3 days for two personnel. Personnel will need to be assigned for duty for the information meeting to discuss the annual program and for the bid opening.

There should be no significant administration and management costs for the government associated with this specific proposed use. Minimum administrative time will be required for annual program development, news release, issuing the special use permits, documenting nutria harvest, issuing harvest reports, and submitting nutria rebate reimbursements.

There would be no special equipment, facilities or improvements necessary to support this management activity.

Since we would not be putting in any facilities or improvements on refuge property for this specific use, there would be no significant maintenance costs associated with this use.

Cost Breakdown:
The following is the list of costs to the Refuge required to administer and manage the furbearer program.

Refuge Personnel Costs		
Conduct Furbearer surveys	(6 days@8 hrs/day@$24/hr.)..	$1,152
Administrative time	(9 days@8 hrs/day@$24/hr.).....	$1,720
Material costs		$ 100
	Total	$ 2,972

Anticipated Impacts on Refuge Purpose(s):
The environmental, socioeconomic, and cultural/historical impacts of these programs are thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan, of which this document is an attachment.

Public Review and Comment:
This compatibility determination will be submitted for public review and comment as an appendices to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X_

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
Trapping programs, virtually identical to the one being proposed, have been conducted on Blackwater NWR for more than 70 years. The attached restrictions, special regulations, and general operations have been structured to ensure compatibility. If the monitoring described under Availability of Resources indicates that this use materially interferes with or detracts from fulfillment of the National Wildlife Refuge System mission or the purposes of the refuge, we would curtail or eliminate the use.

Special Regulations governing our trapping programs are addressed under Part 25-Administrative Provisions of Subchapter C -The National Wildlife Refuge System of 50 CFR and will be subject to Maryland State regulations and special refuge regulations which are contained in the annual trapping program package.

Justification:
Furbearer management activities will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 10 year Reevaluation Date: June 26, 2016

Attachments:
Special Regulations and Restrictions

Trapping Units and Burn study areas (figure E.21)

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ATTENTION BLACKWATER NWR TRAPPING BIDDERS
PLEASE NOTE ITEMS OF INTEREST FOR THE 2003 TRAPPING SEASON:

* 1 Trapping units A, B, E, M, Q, R & S have been removed from the trapping program due to the nutria eradication study.

* 2 Due to errors committed during the 2002 nutria rebate program, several trappers are still owed funds earned during the 2002 trapping season. Those funds will be reimbursed from the 2002 trapping bids before other rebates are awarded.

3 Portions of trapping units G & P & M will continue in the long-term burning study. Portions of these units are set up in no burn, annual burn, 3-5 year burn and 10-year burning areas. See

attached map. Only the annual burn areas of the burn study area will be burned in 2003. Trappers are encouraged to trap the non-burned areas at normal rates.

4 Trappers not fulfilling nutria rebate amount of bid by March 1, 2003, will relinquish funds to a general account which will be available to all refuge trappers.

5 Significant numbers of nutria have been tagged or radio collared. Any trappers finding one of these animals is encouraged to bring the animal to the refuge so necessary information can be collected.

6 Trapping will begin on January 1, 2003, for muskrat, nutria, skunk, raccoon, opossum, and fox on all units.

7 All croplands, woodlands, and impoundments in the area between the Wildlife Drive and Key Wallace road are closed to trapping to prevent waterfowl disturbance.

8 Use of Conibear type size 220 traps will not be permitted within 100 feet of the paved portion of the state/county highway on units D, F, J, K, and O. Use of Conibear type size 110 traps are permitted along roadways provided traps are set below marsh level.

9 One individual may be awarded two units; only one unit will be awarded if bidder makes written statement to that effect on trapping bid.

10 A nutria rebate program will be available to refuge trappers again this year, for nutria killed on the refuge units. Trappers will be reimbursed $1.50 for each nutria tail turned in to the refuge office, not to exceed the amount of the trapping bid. Nutria can be taken by hunting or trapping. Permittees taking nutria by trapping must notify the refuge office in advance and tails must be turned in daily. Permittees taking nutria by hunting must notify the refuge office on the morning of the hunt and turn in tails at the refuge office by 3:30 p.m. of the same day. All tails must be fresh. No frozen tails will be accepted. This rebate will not apply under any other circumstances.

11 All trappers note: Refuge staff will be actively taking nutria on all trapping units. All prospective trappers should bid with this in mind. This intensive effort to remove nutria is necessary to attempt to reduce nutria populations in order to slow extensive damage to marsh vegetation by this exotic animal.

12 A meeting with all interested trappers will be held at 7:00 p.m. on Wednesday, December 11, 2003 at the Refuge Headquarters. A review of refuge regulation changes will be conducted.

13 All refuge trappers should note that rabies continues to be documented in the Blackwater area. Trappers should take necessary precautions such as pre-exposure shots, wearing gloves while skinning game, etc. Rabies can occur in any warm blooded animal from deer to squirrels, etc.

14 Only those refuge lands identified on the attached map are open to trapping. Trappers should consult refuge staff with any questions regarding trapping areas.

15 To prevent disturbances to the eagle roosts located adjacent to Pool 4 (Kuehnle Tract-Trapping Unit K&L). Access will be permitted only between the hours of 8:00 a.m. to 4:00 p.m.

* New for 2003

BLACKWATER NATIONAL WILDLIFE REFUGE
2003 TRAPPING SEASON
INSTRUCTIONS TO BIDDERS

1. Inspection of the units will be allowed December 10 through December 12, between the hours of 9:00 a.m. and 3:00 p.m. A public meeting will be held at 7:00 p.m. on December 11 at the refuge's Headquarters in order to familiarize all prospective trappers with the State and Federal regulations governing the trapping of furbearers on the refuge. Applications must be in the Blackwater Refuge office by 1:00 p.m. on December 18. A public bid opening will be held at the refuge's Visitor Center at 1:00 p.m. on December 18. The mailing address is:

   MUSKRAT BID
   REFUGE MANAGER
   BLACKWATER NATIONAL WILDLIFE REFUGE
   2145 KEY WALLACE DRIVE
   CAMBRIDGE, MD 21613

2. You may submit bids for more than one unit. A bid deposit of $100 is required at the time of bid submission in the form of a bank money order, cashier's check, or postal money order made out to the U.S. Fish and Wildlife Service. Personal checks or cash cannot be accepted. Remaining amount of bid must be received on or before December 31,2002. If a successful bidder defaults on a bid before full payment is made, then the $100.00 bid deposit is forfeited. The defaulted bidder will then be ineligible to bid on refuge trapping privileges for three years.

3. Although you may submit bids for all units, only two units will be awarded to any one individual. High bid will be the unit awarded. If an individual desires only one unit of marsh, a statement to that effect on the bid form will direct refuge personnel to exclude the applicant's bid after the first unit is awarded.

4. No bids or bid changes can be made by telephone.

5. The bid invitation has a summary of the contract, but does not contain all the requirements. The successful bidders for each unit must review and sign the formal contract.

6. A list of units and details of ingress and egress using refuge lands and waters is available at the refuge office.

7. Bid form, general and special conditions are available on request. Each bidder must complete the Application for Refuge Fur Trapping Permit, Form 3-2001, which will also serve as the bid. Be sure to review, sign and complete both sides of this form.

8. Trapping will begin on January 1, 2003, provided full payment has been made, for trapping of muskrat, nutria, raccoon, opossum, skunk, and fox on trapping units.

9. If after full payment has been made and before trapping begins on January 1, 2003, a bidder requests a permit be voided and refund be made, the following will occur:

   The bidder and refuge manager will sign an agreement to that effect, stating that the unit will be re-bid and refund will be the new bid price (not

to exceed the original bid) minus $100.00 penalty to cover administrative costs and re-advertising the unit.

10. A nutria study rebate program will be available to refuge trappers again this year, for nutria killed on the refuge units. Trappers will be reimbursed $1.50 for each nutria tail turned in to the refuge office, not to exceed the amount of the trapping bid. Nutria can be taken by hunting or trapping. Permittees taking nutria by trapping must notify refuge office in advance and tails must be turned in daily. Permittees taking nutria by hunting must notify refuge office on the morning of the hunt and turn in tails at the refuge office by 3:30 p.m. of the same day. All tails must be fresh. No frozen tails will be accepted. This rebate will not apply under any other circumstances. These restrictions are necessary to ensure that reimbursements are made only for nutria taken on Blackwater Refuge.

11. Trappers not fulfilling nutria rebate amount of bid by March 1, 2002, will relinquish funds to a general account which will be available to all refuge trappers.

12. Refuge staff will be actively taking nutria on all trapping units. Bidders should keep that in consideration when bidding.

BLACKWATER NATIONAL WILDLIFE REFUGE
2003 TRAPPING SEASON
SPECIAL CONDITIONS APPLICABLE TO ALL UNITS

1. All trapping activity must comply with State and special refuge regulations, including boating regulations. Trapping of muskrat will begin on January 1, 2003 and end on March 15, 2003.

2. Fur animals authorized to be taken on the refuge may be taken only with ordinary steel traps or with other traps which have been approved by the refuge manager. The refuge manager may require the permittee to locate his traps in designated parts of his trapping unit (see special conditions for each unit). Unless specifically waived by the refuge manager, the permittee shall visit and inspect each of his traps within the refuge at least once every 24 hours, but he shall not run his traps or visit traps between sunset and one-half hour before sunrise of the following day. Permittees must advise refuge manager daily by phone or in person if sickness or any other reason, including weather conditions, prevents compliance with the 24 hour inspection regulation. At the close of the trapping season, the permittee shall take up all his traps and remove them from the refuge. The permittee may cut on the refuge, for use as trap stakes or drags, only such species of brush or timber as the refuge manager shall designate.

3. Birds and mammals, other than those covered by and taken under this permit, that are found alive in the traps by the permittee shall immediately be liberated. Any such unauthorized birds and/or mammals found dead or mortally injured in the traps shall immediately be turned over to the refuge manager or his representative. Trappers should record any incidental catches of non-target species, as this will be part of the information requested by the refuge at the close of the season.

4. This permit is not transferable, and no privilege hereunder may be sublet or made available to any person or interest not a party hereto without the approval of the refuge manager. Permittee must be present on area when trapping is carried out. One helper will be allowed. If helper is less than eighteen years of age, written authorization from the refuge manager is required.

5. Ingress and egress from the refuge shall be only by routes of travel designated by the refuge manager.

6. The permittee shall, not later than fifteen days after the conclusion of trapping on the refuge, submit to the refuge manager a report in which are correctly stated the number of each species of animals taken on the refuge.

7. All furbearers, <u>except otter</u> may be taken. setting any trap in the vicinity of otter sign and/or activity is prohibited to prevent the accidental taking of otter. Use or possession of Conibear type 330 is prohibited. Foothold traps normally used for otter are prohibited. Any foothold trap with a jaw spread of more than four inches must be approved by the refuge manager. Use or possession of snares of any description is prohibited. Bait sets with foothold traps are not permitted. The use of foothold trap sets around an animal carcass -- draw station -- are prohibited.

8. Approved foothold traps may be set for nutria in open marsh. Only one trap per set may be used.

9. Use of Conibear type size 220's and foothold traps are prohibited in upland areas of the refuge with the exception that approved foothold traps will be permitted for use with dirt hole sets for fox on wooded islands in the interior of the refuge provided no other restrictions are in place. See maps at refuge office for locations.

10. All successful permittees from the period of the bid award may enter his unit during daylight to check for trespass. Permittee must notify the office prior to entering upon the refuge units.

11. NO MARSH BURNING IS PERMITTED BY THE TRAPPER. All burning will be done by refuge personnel. Burning will be carried out as soon as possible after January 1. Trappers should take into account when bidding that some of the units may not be completely burned. Trapping Units G and P will have sections of marsh which will be burned on an annual burn, 3-5 year burn, 10 year burn and a no burn rotation. (See figure E. 21).

12. All bidders must have obtained the age of majority in the State of Maryland which is eighteen (18) years of age.

13. Failure by the permittee or his helper to comply with any of the above provisions or the violation by him of any of the refuge regulations or of any State law or regulation applicable to trapping on said refuge, not only shall render him subject to prosecution under said laws and regulations, but shall constitute cause for the revocation of this permit and for refusal of a permit for trapping fur animals during the next following open season or for any other use of privilege on the refuge for which a permit may be required by regulations. This permit may be terminated at any time by agreement between the issuing officer and the permittee; it may be revoked by the issuing officer for non-use.

14. Permittee is responsible for knowing his/her refuge trapping unit boundary. Care should be taken to prevent trespass on adjacent units and private lands. Refuge cannot grant permission for access across private lands.

15. No trapping will be permitted within 200 yards of any eagle nest on or adjacent to the refuge. Permittee should check on those areas with an old nest and possibly any new nest since last trapping season. Trapping may be permitted in these areas once it has been determined by the refuge staff that the nest is not active for that year.

16. Parking areas and access routes will be designated by the refuge manager.

17. Permittees supplied with keys to refuge gates are responsible to return keys within fifteen (15) days after conclusion of trapping on the refuge. Permittee is responsible for closing refuge gates upon entering and exiting refuge and is responsible for keeping refuge keys in his/her custody at all times.

18. The refuge manager reserves the right to restrict traffic on any refuge access roads due to weather, wet conditions, eagle nest construction, etc. Permittees are responsible for any damage they cause to refuge roads during bad weather, wet conditions, etc.

19. Off road vehicles (ATV, marsh buggies, trail bikes, etc.) are prohibited for use on refuge lands.

20. Air boats and air boat use are prohibited on refuge waterways.

21. Permittees are authorized to carry a .22 caliber firearm to dispose of all trapped furbearers, except muskrats and otter.

22. Permission may be received from the refuge manager authorizing additional helpers and dogs for taking nutria. Permittee must be present during nutria hunt. Permittee is responsible for the helpers and their activities. This regulation will be strenuously enforced during this trapping year.

23. Refuge staff members will be taking an active role in taking nutria on all refuge units.

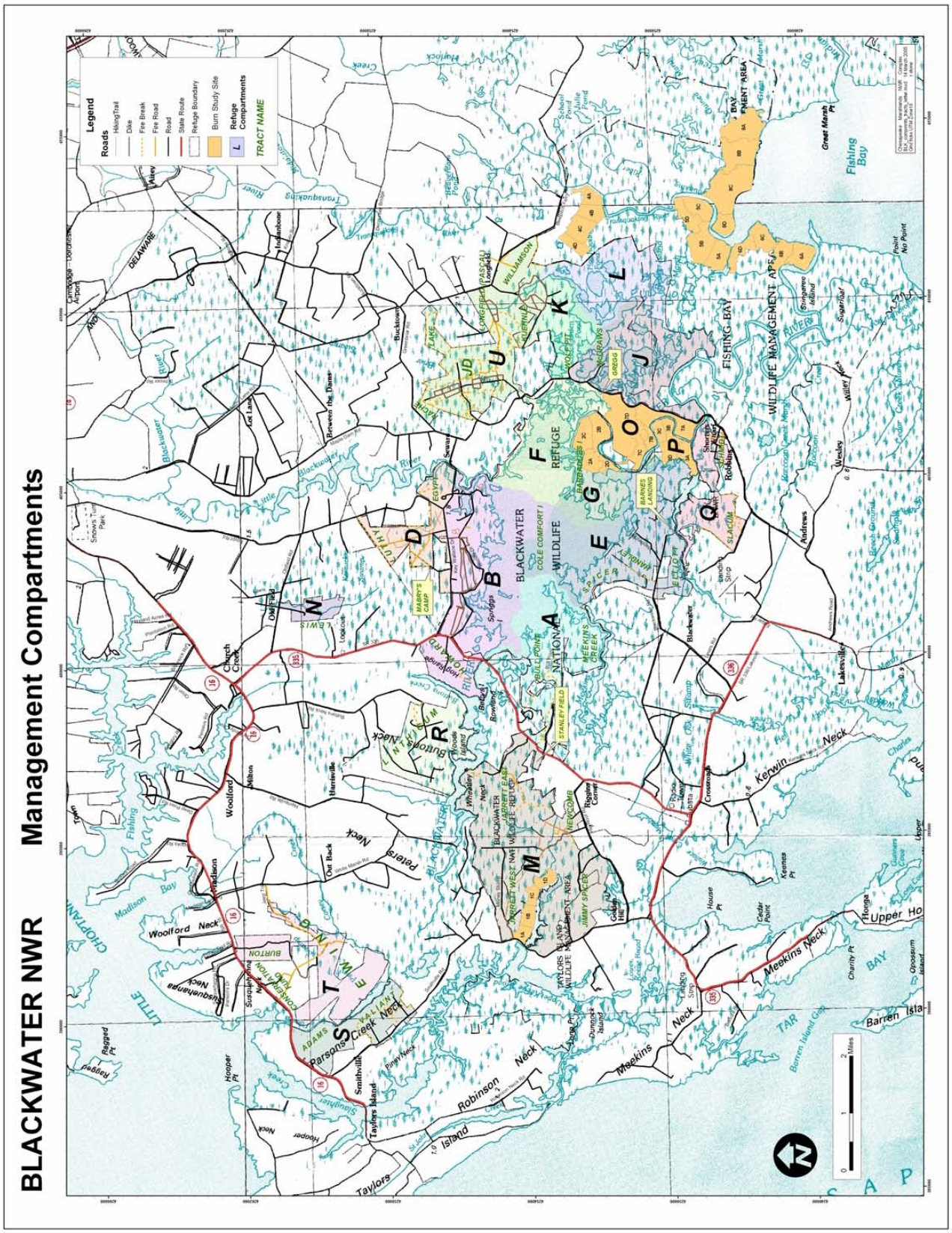


Figure E. 21. Trapping units and Burn study sites

2003 TRAPPING SEASON
SPECIAL CONDITIONS FOR EACH UNIT

In addition to the general refuge regulations, there are specific conditions that apply to units listed below.

UNIT "D"

(1) No foothold traps will be permitted within 100 yards of the paved portion of the county road.

(2) No trapping will be permitted within 200 yards of eagle nest on adjacent land.

(3) Trapping will be permitted in the uplands of this area by use of live traps only.

(4) Use of Conibear type size 220 traps will not be permitted within 100 feet of the paved portion of the county highway. Use of Conibear type size 110 are permitted along roadway provided traps are set below marsh level.

UNIT "F"

(1) No foothold traps will be permitted within 100 yards of the paved portion of the county road.

(2) Use of Conibear type size 220 traps will not be permitted within 100 feet of the paved portion of the county highway. Use of Conibear type size 110 are permitted along roadway provided traps are set below marsh level.

(3) No trapping will be permitted within 200 yards of eagle nest on this unit.

UNIT "G"

(1) No trapping will be permitted within 200 yards of any eagle nest on this unit.

(2) Consult refuge manager regarding fox trapping on islands located on this unit.

(3) A refuge burn study area is located in this unit. The annual burn section of the study area will be burned.

UNIT "J"

(1) No trapping will be permitted within 200 yards of any eagle nest on this unit.

(2) Consult refuge manager regarding fox trapping on island locations on this unit.

(3) No leghold traps will be permitted within 100 yards of the paved portion of the county road.

(4) Use of Conibear type size 220 traps will not be permitted within 100 feet of the paved portion of the county highway. Use of Conibear type size 110 are permitted along roadway provided traps are set below marsh level.

UNIT "K"

(1) No trapping will be permitted within 200 yards of eagle nest on this unit.

(2) Trapping will be permitted in the uplands of this area by use of live traps only. Consult this area by use of live traps only. Consult refuge manager regarding fox trapping on islands located on this unit.

(3) NO leghold traps will be permitted within 100 yards of the paved portion of the county road.

(4) Use of Conibear type size 220 traps will not be permitted within 100 feet of the paved portion of the county highway. Use of Conibear type size 110 are permitted along roadway provided traps are set below marsh level.

(5) To prevent disturbance to eagles utilizing the roost area, road access will be permitted only between the hours of 8:00 am to 4:00 pm.

UNIT "L"

(1) Trapping will be permitted in the uplands of this area by use of live traps only. Consult refuge manager regarding fox trapping on islands located on this unit.

(2) Part of the woodland area of this unit will be closed to protect an eagle roosting area. Consult refuge manager for area definition.

(3) To prevent disturbance of eagles utilizing roost area, road access will be permitted only between the hours of 8:00 a.m. to 4:00 p.m.

UNIT “O”

(1) Use of Conibear type size 220 traps will not be permitted within 100 foot of the paved portion of the county highway. Use of Conibear type size 110 are permitted along roadway provided traps are set below marsh level.

(2) No leghold traps will be permitted within 100 yards of the pave portions of the county road.

COMPATIBILITY DETERMINATION

Use: Big Game Hunting for White-tailed Deer, Sika Deer, and Eastern Wild Turkey

Station Name: Blackwater National Wildlife Refuge

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table I summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):
For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."

For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."

For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other

fish and wildlife in North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:
"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of deer and spring turkey hunting programs with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is Big game hunting for white-tailed deer, sika deer, and Eastern wild turkey. The National Wildlife Refuge System Improvement Act of 1997 identified hunting as one of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the act encouraged the Service to provide opportunities for these uses

Background and Rationale for the Management Activity

In the 1930's when Blackwater Refuge was first established as a refuge for migratory birds, especially wintering waterfowl, hunting in Dorchester County was a means of providing food for the table as well as an accepted popular form of recreation. Most of the area was rural and the local population hunted on their own land and also allowed others to hunt their property. The Blackwater Refuge was considered a sanctuary for wildlife and protected from poachers. Few visitors came to Blackwater Refuge.

A 1949 amendment to the Duck Stamp Act permitted hunting on 25 percent of the lands purchased for the National Wildlife Refuge System with Duck Stamp funds, but Blackwater Refuge remained closed to hunting (Note: Later amendments authorized up to 40%). After World War II, Americans traveled the nations's back roads and discovered their National Wildlife Refuges. Interest developed in using refuges for recreation other than hunting. Although most wanted to share with their families the sights and sounds of wildlife and the wonders of the living world, many citizens wanted to use their refuges to sail, swim, camp, water ski, ride horses, sun bathe, and rock climb. Guidance in the first Refuge Manual (1943) left the door open to uses for the cause of building public support, but conflicts between wildlife and public uses could be forecast. In the 1957 Refuge Manual, guidance on how to decide which public uses to allow hinted towards a wildlife first priority, but sent mixed signals. However, the Refuge Recreation Act of 1962 and the Refuge Administration Act of 1966 placed into law the concept that refuges would be closed to all recreation uses, until a manager could determine that a proposed use was compatible with the refuge's establishing purpose and that sufficient funds were available to administer those uses. Refuge managers were responsible for making these compatibility determinations. Usually decisions were made locally, and in many cases, were based on local pressures and interests. The first formal compatibility determination for big game hunting on Blackwater Refuge was approved on August 26, 1994.

Waterfowl hunting has always been a major recreational activity in Dorchester County, but when hunters discovered the abundance of deer and especially the exotic sika that could not be found elsewhere, they

swarmed to the area. Interest in hunting on Blackwater Refuge increased. When the farming community complained that the ever increasing population of deer on Blackwater Refuge seriously depredated their crops, interest in promoting hunting on Blackwater Refuge increased even more. To assist with the crop situation and provide recreation, Blackwater Refuge began a deer hunting program in 1985. Although the current program allows most of the hunters that apply to participate, hunters, during the CCP scoping meetings, indicated a desire for increased opportunities to deer hunt. They also requested a turkey hunt.
.

(B) Where would the use be conducted?

Deer and turkey hunting will occur on approximately 10,430 acres (currently and increasing with additional acquisitions) or approximately 38% of the existing refuge. Hunting areas are located in upland forest and forested wetland habitats away from public use areas, high density waterfowl use areas, and away from the majority of marsh and open water (figures E.22 and E.23). Portions of the marshes adjacent to forested wetlands are hunted for sika deer; however, these areas are not intensively used by waterfowl as evidenced by our biweekly aerial waterfowl surveys.

Spring turkey hunting will occur on approximately 7,485 acres in 10 areas (Areas B1, D, M2, N, R, S, T, U1, U2, and U3, figure E.22) (27% of the existing refuge). Like deer hunting, turkey hunting areas are located in upland forest and forested wetland habitats away from public use areas, high density waterfowl use areas, and away from the majority of marsh and open water.

(C) When would the use be conducted?

Hunting for white-tailed and sika deer would be permitted for a minimum of 53 days (45 days of archery hunting generally beginning the last Saturday in September, continuing consecutively until mid-November, and ending with a late archery season beginning the first Saturday in January and ending the third Saturday in January; 2 days of muzzleloading rifle or shotgun hunting the third Friday and Saturday in October; two days of youth only shotgun hunting the second and fourth Saturdays in November; and 4 days of shotgun hunting the first and second Mondays and Fridays of the state-wide firearms season), all within State seasons, and consistent with State weapons/bag limits/hunting hours. Deer hunting will be permitted on the aforementioned dates from one-half hour before sunrise to one-half hour after sunset.

Hunting for turkeys (gobblers only) will be authorized on Tuesdays and Saturdays for 5 weeks (10 days) during the State season (April 18 to May 16), on a quota basis, in compliance with state hunting regulations, and from one-half hour before sunrise until noon on designated hunt days. Turkey hunting would require a permit determined by a lottery system issued to 14 hunters per day (140 hunters). Scout days would be authorized the day before each hunt day. New areas would be evaluated and considered as they are acquired that would not conflict with public use areas or endangered and threatened species (bald eagle) and would not have a negative impact on other wildlife and habitat resources or public safety. A youth only quota hunt will be authorized the first Saturday of the State season.

(D) How would the use be conducted?

During the spring turkey and deer archery seasons, hunters would "walk in" from existing designated parking areas, and all vehicle access would be prohibited. During the firearms seasons, vehicles would be restricted to designated roadways and existing parking areas. There would be no off-road vehicles or ATV use allowed during any hunting season. There would be no access allowed by boats during any of the big game hunting seasons. The first section of the Wildlife Drive would only be closed the first day of the shotgun hunt, leaving the second part of the Wildlife Drive open for public use. Hunting opportunities would be provided to a minimum of 3,000 hunters annually on a first come, first served, mail in system (non-quota for the archery season, but with quotas for the firearms hunts). Hunters would be restricted to zoned areas for safe distribution, with a ratio of no more than 1 hunter per 20 acres, although some areas may have only 1 hunter per 40 acres.

Blackwater Refuge would honor the commitments related to Blackwater Refuge acquisitions where the Service assured the public that the historical tradition of hunting deer would be permitted if compatible with

the objectives of Blackwater Refuge. With the acquisition of additional property, the refuge would open other areas suitable to hunting with the number of hunters per acre the same, and would increase the number of total hunters accordingly. Check stations would be operated by staff and volunteers during muzzleloader and shotgun hunts to obtain age, sex, species, and weight data. Deer killed during the archery season would be required to be checked at a specified Maryland DNR certified checking station. An annual hunt program would be prepared and submitted for review prior to July 1. Summaries of the biological information would be published in the refuge's Annual Narrative Report. Administrative fees would be charged for the permits. Senior citizens and youth would receive a 50% discount on these fees. Fees would be utilized to hire a hunt program coordinator and maintain parking areas and signs.

One area of the refuge would be designated for certified wheelchair bound big game hunters. Hunt leaflets, regulations, and maps would be prepared and published annually, and distributed to hunters. Refuge specific regulations would be published annually in the Federal Register and codified in Title 50, Part 32. A hunter data base would be maintained to facilitate mailings and distribution of information. Blackwater Refuge would continue the same precautions for threatened and endangered species and migratory waterfowl as in Alternate A. Hunting would be regulated in time and space to eliminate conflicts with endangered species and other public uses and to ensure compatibility with refuge purposes. Annual spotlight surveys, harvest data, herd health conditions, and available habitat would continue to ensure that the deer hunt remained biologically sound.

Deer hunting, while maintaining herd numbers within acceptable levels, would continue to provide opportunities to utilize a renewable resource. Hunting seasons would be adjusted annually to take into consideration changes indicated in herd quality by biological monitoring [APCs (abomasum parasite counts), antler size, reproductive rates, etc.].

(E) Why is the use being proposed?
Deer hunting will be conducted to achieve an integral part of the refuges comprehensive wildlife management program. Specifically, the deer management goals are to: Maintain a healthy deer population at or below habitat carrying capacity; minimize crop depredation to refuge and adjacent private croplands; minimize Delmarva fox squirrel (DFS) habitat degradation and deer competition with the squirrel; keep the exotic sika deer numbers at a level compatible with its habitat to prevent the species from increasing its range inland, thereby intruding into and competing with the native white-tailed deer; and provide quality, compatible, consumptive, wildlife-oriented recreation.

Spring turkey hunting is being proposed to provide quality, compatible, consumptive, wildlife-oriented recreation.

Availability of Resources:
The Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex recommends two full-time law enforcement officers (one at Blackwater and one for the Nanticoke Division) to conduct this and other hunt programs. One full-time officer was hired in FY2003. Combined with the existing two collateral duty refuge officers, there will be sufficient personnel to ensure compliance with regulation, protection of the resources, and public safety when all these positions are filled.

All hunting programs and supporting activities would be totally administered and funded by the Friends of Blackwater, who would also hire and pay for a full-time hunt coordinator. The Hunt Coordinator would administer all aspects of these hunting programs; respond to all questions and provide information to the public; process hunt applications and permits; conduct mailings; provide visitor assistance for the hunt programs; improve customer service; make a positive impression to customers and the public; provide maintenance of signs and parking areas; and otherwise assist hunters in following regulations and enjoying a good hunting experience, all at no cost to the government. Friends of Blackwater will continue to fund the annual publication of regulations, permit applications, maps, and leaflets. Any remaining revenue generated

from the administrative process and permit application fees would be used to replace signs, post closed areas, and maintain parking areas and roads.

There should be no significant administration and management costs for the government associated with this specific proposed use.

There would be no special equipment, facilities or improvements necessary to support the amount of big game hunting anticipated.

Since we would not be putting in any facilities or improvements on refuge property for this specific use, there would be no significant maintenance costs associated with this use.

Monitoring costs associated with maintaining statistical information on hunting activities, kill, age/sex ratios, etc. will be assumed by Friends of Blackwater who will staff the check stations.

Cost Breakdown:
The following is the list of costs to the Refuge required to administer and manage the hunting programs.

Refuge Personnel Costs

Archery (45 days @ 3 hrs/day@$24/hr.)	$3,240
Muzzleloading (2 days @ 9hrs/day@$24/hr.)	$ 432
Shotgun (4 days @ 9hrs/day@$24/hr.)	$ 864
Turkey hunts (10 days @ 4 hrs/day@24/hr.)	$ 960
Total	$5,496

All other costs will be paid for by the Friends of Blackwater.

Anticipated Impacts on Refuge Purpose(s):
The following is a summary of the environmental, socioeconomic, and cultural/historical impacts of these programs as more thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. Impacts from the deer hunts are anticipated to be minimized as demonstrated by closely monitoring impacts of annual hunts during 1972 and from 1985 to present.

Impacts on endangered species and their habitats would be minimized by taking several precautions. In accordance with the "Management Guidelines for Bald Eagles in the Chesapeake," hunting near eagle nests would be restricted to a minimum radius of 250 yards. Open marsh areas, where eagles typically feed, would be entirely closed to hunting, and eagle roost sites would be protected by a ¼-mile minimum buffer zone where no entry is permitted. Eagle activity usually increases in late December and nesting begins in early January, well after deer hunting seasons end. All young eagles would be fledged prior to spring turkey season.

Delmarva fox squirrels are found in the upland hunting areas, but hunter/squirrel encounters are expected to be brief and generally non-disturbing. Almost 100% of white-tailed deer hunters use deer stands, when questioned during hunter check-in. Consequently, most hunter movement only would involve going to and coming from their stand. This is especially true during the archery hunt. Law enforcement patrols during past hunts observed very little movement from deer hunters. Furthermore, sika deer are hunted primarily in wet forest, where DFS are less frequently observed.

Impacts on habitat are expected to be minimal and then only temporary, as trampled ground vegetation will recover. During the archery and spring turkey seasons, hunters must "walk in" from designated, existing parking areas, and all vehicle access will be prohibited. During the deer firearms season, vehicles will be

restricted to designated roadways. There will be no off-road vehicles or ATV uses allowed during any hunting season. Personal observation of the habitat during hunting season would lead a biologist to suspect the deer population, especially bucks, does more damage to the vegetation with numerous scrapes, antler polishing on saplings, and browsing woody vegetation, than the hunters damage.

Impacts on public use are especially minimal. Public use facilities are totally unaffected by the archery hunt. The only time the self-guided trails and the wildlife drive is closed during the first day of the four-day firearms season (0.25% of the year). Even then, a portion of the wildlife drive remains open for visitor use. The visitor center remains open and is unaffected by the deer hunt. The remainder of the refuge hunt areas is closed to public entry throughout the year.

Waterfowl use areas such as the moist soil impoundment system, adjacent cropland, and marsh are closed to hunting, and are not impacted.

Public Review and Comment:
This compatibility determination will be submitted for public review and comment as an appendices to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X_

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
These hunting programs have been conducted for many years and the special regulations, restrictions, and general operations have been structured to ensure compatibility. If the monitoring described under Availability of Resources indicates that this use materially interferes with or detracts from fulfillment of the National Wildlife Refuge System mission or the purposes of the refuge, we would curtail or eliminate the use.

Special Regulations governing our hunting programs will be codified in the Code of Federal Regulations, Title 50 and will be subject to Maryland State regulations and the following special refuge conditions:

1. We require refuge permits for all hunters regardless of age. We require that permits must be in the hunter's possession along with a valid Maryland State hunting license, any required stamps, and a photo identification. Permits are non-transferable.

2. We require that hunt permits be obtained only through the mail by mailing an application and administration fee to the refuge after applications are made available in July. To obtain an application and regulations leaflet (including designated areas and map, dates of hunts, bag limits, and permit fees) for archery, youth, muzzleloader, and shotgun deer hunts and turkey hunts, we require hunters to contact the refuge hunt coordinator or refuge Visitor Center between the hours of 9:00 am and 4:00 pm daily.

3. We allow archery hunters to obtain a permit at the Visitor Center after the first week of September until the end of the archery season.

4. We allow walk-in youth deer hunters to obtain a permit at the check station on the day of the hunt.

5. We require youth hunters to be at least 12 years old but less than 16 years old, and require that they be accompanied by a licensed or exempt from licensed, unarmed adult, 21 or older. We require the accompanying adult to remain with the youth at all times in the field.

6. We require a permanently disabled hunter to be certified "wheelchair-bound" by a physician, and to be accompanied by an assistant who is not permitted to use a firearm. We require the permanently disabled certification to accompany the hunters permit application.

7. We allow only participants possessing authorized permits to enter the hunt areas.

8. We require check-in for all hunts, except archery and turkey hunts, beginning at 5:00 am.

9. We require all deer killed during all hunts except archery hunts to be properly tagged and presented for examination at the refuge check station on the day of the kill.

10. We require hunters to seek refuge employee assistance to retrieve deer or turkeys from closed areas.

11. We do not require check-in or check out at the refuge for the archery hunt and turkey hunts, but we require harvested deer and turkey to be registered at one of the Maryland check stations designated by the refuge.

12. We require only weapons that meet Maryland State regulations. We do not allow handguns and breech-loading rifles.

13. We allow access to hunt areas only on designated roads and parking areas indicated on hunt maps in the regulations leaflet (obtained with application by mail or at the Visitor Center). All other access is limited to walk-in or bicycles. We do not allow access by boats or ATV's.

14. We allow scouting only on designated days listed in the regulations for permitted hunters.

15. We do not require check-in or check-out for scouting.

16. We do not allow firearms or other weapons on the refuge when scouting.

17. We require permitted youth hunters to be accompanied by permitted adult age 21 or older while scouting.

18. We require a minimum of 400 square inches of solid-colored daylight fluorescent orange clothing to be worn on the head, chest, and back of all deer hunters during the youth, muzzleloader, and shotgun hunts.

19. We require the use of a tree stand that elevates the hunter a minimum of 8 feet above the ground for deer hunting in Area B2 (except disabled hunters). Temporary, removable, ladder, fixed, and climbing-type tree stands that do not damage trees are permitted in all other areas.

20. We do not allow screw-in steps, spikes, or other objects that may damage trees.

21. We do not allow hunting from a permanently constructed tree stand.

22. We allow tree stands to be pre-installed during the scouting days for use during the selected hunts, and to be left in the hunting area at the hunter's discretion. We require all stands to be

removed the last day of the refuge hunting season (we will not be held responsible for damage, theft or other hunter occupancy).

23. We do not allow pets in hunt areas.

24. We do not allow hunting from or shooting across a roadway where vehicle traffic is allowed.

25. We do not allow driving deer during youth hunts.

26. We do not allow commercialized guiding.

Justification:
As a federally mandated steward of the Nations wildlife and other natural resources, the U.S. Fish and Wildlife Service and Blackwater National Wildlife Refuge have an obligation to the State of Maryland, the Eastern Shore, and Dorchester and Wicomico Counties to manage a deer population equally shared by the Refuge and private lands adjacent to the refuge in such a manner as to not violate the purposes for which the refuge was established. At the same time, the refuge must honor the commitments related to refuge acquisitions where the Service assured the public that the historical tradition of hunting deer and other wildlife would be permitted if compatible with the objectives of the refuge.

It has been determined in the preceding sections that deer and spring turkey hunting programs are compatible. Palmer et al. (1980) and Cypher (1988) state that the only biologically sound and cost effective method to keep a deer population in balance with its environment is through regulated hunting. Over-browsing by an unmanaged deer population has a detrimental effect on understory vegetation and on regeneration of hardwoods (Butt 1984). Likewise, an unmanaged deer population causes severe crop depredation on refuge property and on the property of adjacent land owners. This crop depredation results in negative socioeconomic impact on the private landowners as well as competition with migratory waterfowl and the endangered Delmarva fox squirrel. Croplands can account for 41% of the annual diet in deer even though other prime food sources are available (Dusek et al. 1989).

A regulated deer hunt is essential to accomplish the goal of managing a healthy deer population, resulting in high reproductivity and recruitment for both consumptive and non-consumptive wildlife-orientated recreation. Dickerson (1983) noted the drastic effect of the "no hunting" approach to deer management. He examined harvested deer from a state park in New York where hunting had been prohibited for 71 years. Through these observations, he concluded that due to the lack of hunting, the deer herd was in the worst physical condition of any he had observed in New York and possibly the northeast.

Limited spring turkey hunting in accordance with the restrictions and numbers of hunters proposed would have insignificant impacts on biological resources, with the exception that obviously a few gobblers would be killed. However, their removal from the population would not have significant impacts on the species or its abundance.

Big Game Hunting for white-tailed deer, sika deer, and Eastern wild turkey will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the Refuge was established.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 15 year Reevaluation Date: June 26, 2021

Attachments:

Tract descriptions (table E.2) and Hunting Maps (Figure E.22 and E.23)

References:

Butt, J.P. 1984. Deer and trees on the Allegheny: how could hunters keep the deer and the forest service keep regeneration when the deer were eating the regeneration? Journal of Forestry 82(1984):468-471.

Cline, K. 1985. Bald Eagles in the Chesapeake: A Management Guide For Landowners. National Wildlife Federation. 16 pp.

Cypher, B.L., E.A. Cypher. 1988. Ecology and management of white-tailed deer in northeastern coastal habitats: a synthesis of the literature pertinent to the National Wildlife Refuges from Maine to Virginia. U.S. Fish and Wildlife Service, Biological Report 88(15). 52 pp.

Dickinson, N.R. 1983. An example of the effect of underharvesting on a deer population. N.Y. Fish and Game Journal 30(1983):231-232.

Dusek, G.L., R.J. Mackie, J.D. Herriges, Jr., B.B. Compton. 1989. Population ecology of white-tailed deer along the lower Yellowstone River. Wildlife Monographs 104:1-68.

Larson, T.J., O.J. Rongstad, F.W. Terbilcox. 1978. Movement and habitat use of white-tailed deer in southcentral Wisconsin. Journal of Wildlife Management 42(1):13-117.

Palmer, D.T., D.A. Andrews, R.O. Winters, and J.W. Francis. 1980. Removal techniques to control an enclosed deer herd. Wildlife Society Bulletin 8(1):29-33.

Table E.2. Land acquisition history (Blackwater NWR)

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
1/13/33	18	1.00	Graveyard Tract	MBCA
1/13/33	19	72.00	Blackwater R.	MBCA
1/23/33	14,a,-I,-II,-III,b–g,i	8,167.99	Delmarvia Fur Farms	MBCA
12/01/42	16,a	355.18	Kuehnle	MBCA
8/02/45	24,a–c	2,203.21	Seward	MBCA
4/21/51	29	416.94	Smith	MBCA
6/22/72	37	408.40	Luthy	MBCA
6/23/72	38	1.15	Brooks	MBCA
6/29/72	31	1.28	Turner	MBCA
6/27/75	45,R	175.10	Spicer	ESA
5/15/78	45b–d	1,610.47	Jarrett	ESA
9/28/78	45a–e	852.84	Jarrett	ESA

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
10/09/84	58,-I	489.50	Handley	ESA
4/19/85	53,-I	863.00	Herman Robbins Est.	MBCA
4/20/64	41,R	0.00	State of MD Easement	MBCA
11/05/76	2	7.14	State of MD Exchange2	80 STAT. 926
3/02/77	14d	(9.89)	State of MD Exchange3	16 U.S.C. 668dd
8/11/87	54	71.40	Schmidt	RRA
10/21/87	55,-I	237.20	Wm. Robbins	RRA
11/02/88	99,R	445.00	Paul Handley Est.	MBCA
11/09/88	52	297.20	Rufus Robbins	MBCA
4/09/91	100	454.20	Pascal	MBCA
10/21/91	51,-I	562.70	Gregg	MBCA
12/24/91	100a–i	176.75	Barren Island	MBCA
12/30/92	101	797.78	Williams	MBCA
12/28/92	100m	459.47	Howard	RAA
12/30/92	100j	380.00	Bishops Head	RAA
12/30/92	100k	52.00	Spring Island	RAA
2/28/94	100n	856.00	Madison (Ewing)	NAWCA
8/10/94	59	201.00	Mills	MBCA
11/2/94	103	299.95	Burton	MBCA
2/7/96	100t	173.85	Elliott	MBCA
12/28/95	104a	324.34	Valiant	MBCA
5/23/96	100r	55.23	Rasche	MBCA
8/6/96	100u	1,163.06	Linthicum	MBCA
7/29/96	100p,q	431.26	Lakes	MBCA
12/16/97	100Ae	149.73	Williamson	MBCA
9/24/99	108	74.88	Spicer	MBCA
9/24/99	107r	748.26	Spicer	MBCA
7/26/99	100Af	26.50	Long	MBCA
3/29/99	105,a	174.48	LeCompte	MBCA
3/28/00	100Ag	64.73	Riggins	MBCA
6/29/72	31	1.28	Turner	MBCA

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
3/15/00	54a	141.60	Schmidt	MBCA
2/6/02	100Ah	109.81	Newcomb	MBCA
2/20/02	100Ai	89.25	Newcomb	MBCA
6/26/93	102	0.11	Wooten	MBCA
7/8/00	106	149.06	Stanley	MBCA
6/28/00	111	139.10	Elliott	MBCA
1/4/00	113	215.80	Lewis	MBCA

[1]MBCA: Migratory Bird Conservation Act; ESA: Endangered Species Act; RRA: Refuge Recreation Act; NAWCA: North American Wetlands Conservation Act; RAA: Refuge Administration Act
[2]Received in an exchange with the State of Maryland for land of equal value
[3]Given in an exchange with the State of Maryland for land of equal value

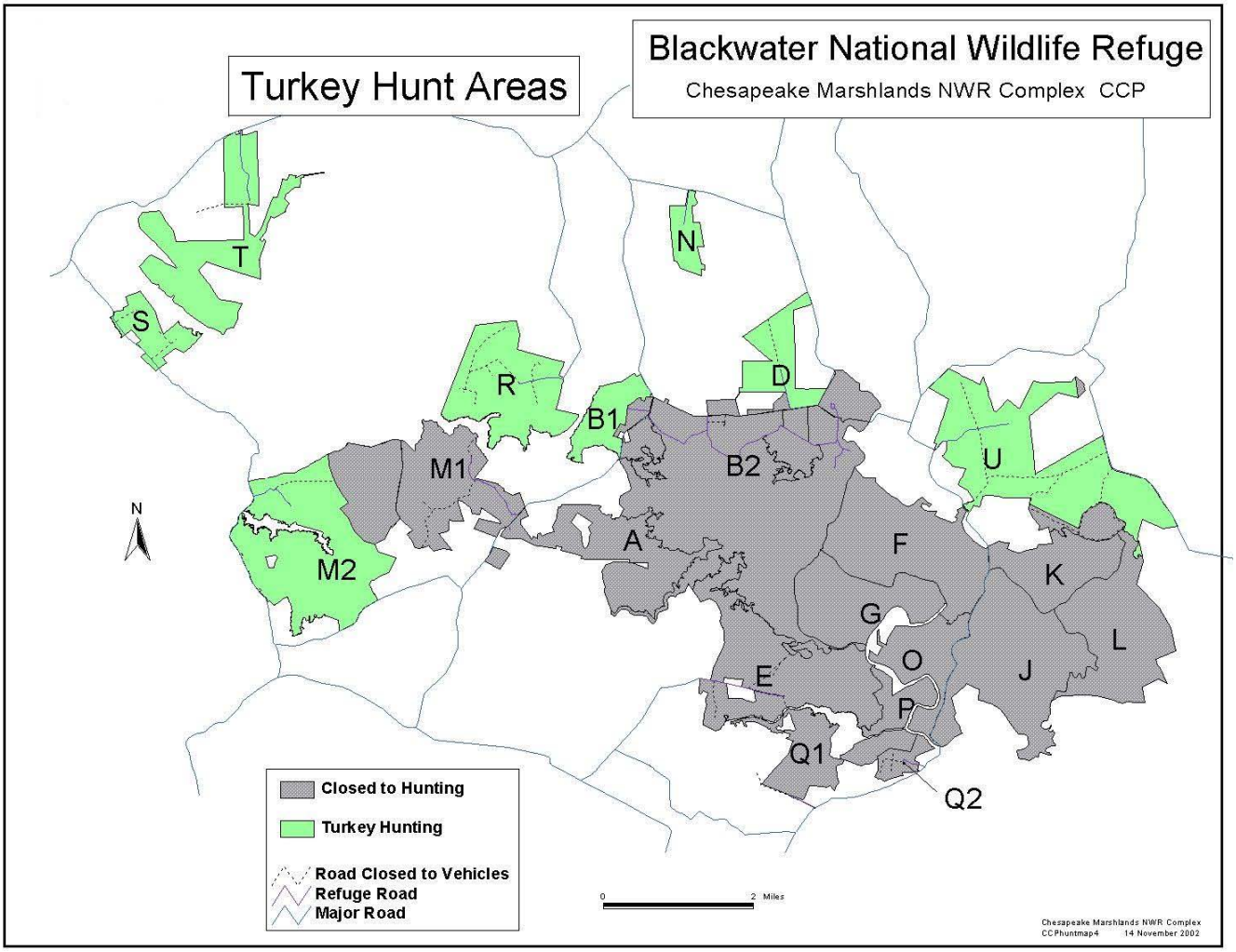
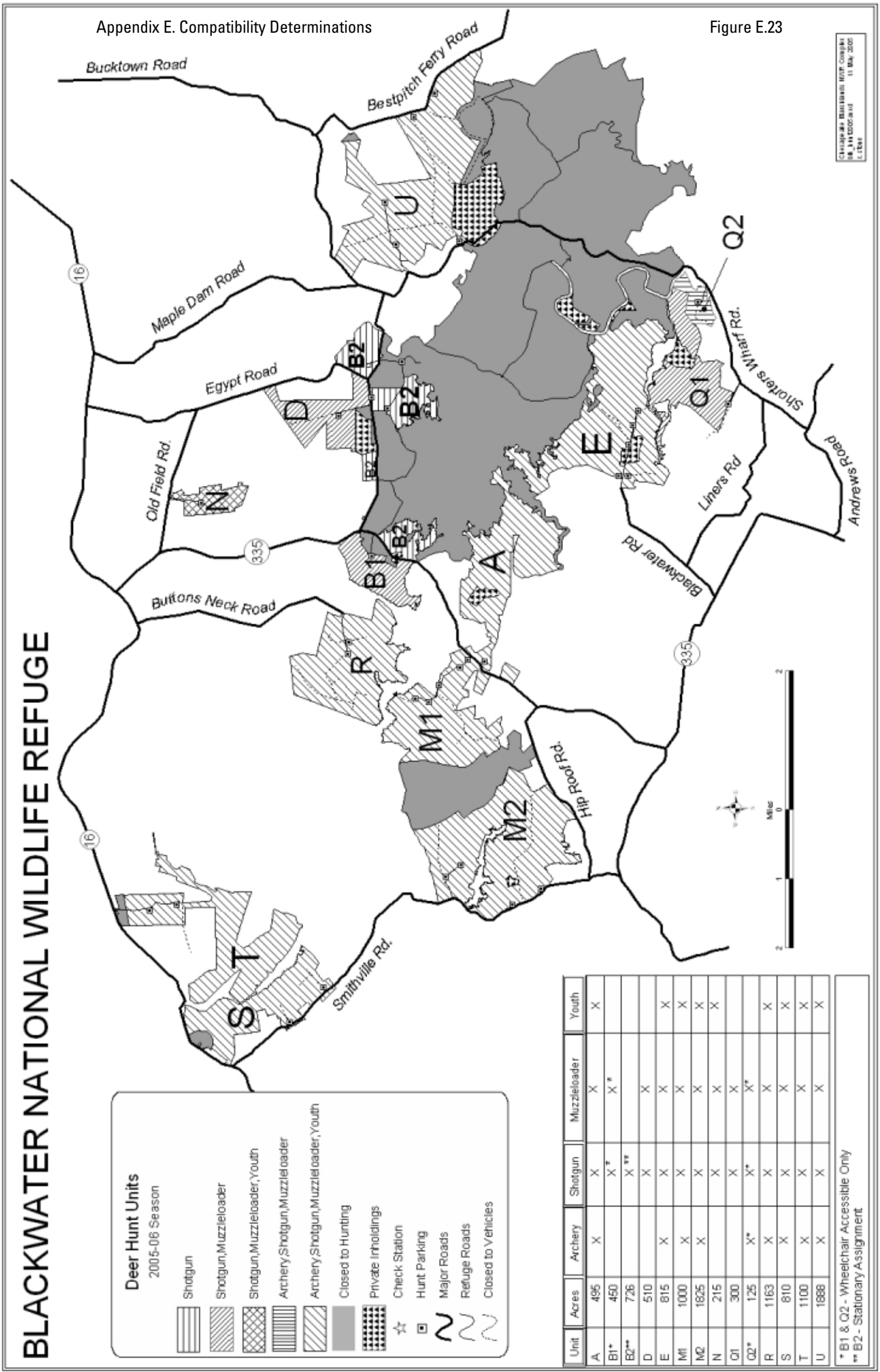


Figure E.22. Turkey Hunting Areas



Unit	Acres	Archery	Shotgun	Muzzleloader	Youth
A	495	X	X	X	X
B1*	450		X*	X*	
B2**	726		X**		
D	510		X	X	
E	815	X	X	X	X
M1	1000	X	X	X	X
M2	1825	X	X	X	X
N	215		X	X	X
Q1	300		X	X	
Q2*	125	X*	X*	X*	
R	1163	X	X	X	X
S	810	X	X	X	X
T	1100	X	X	X	X
U	1888	X	X	X	X

* B1 & Q2 - Wheelchair Accessible Only
** B2 - Stationary Assignment

COMPATIBILITY DETERMINATION

Use: Hunting - Waterfowl

Station Name: Blackwater National Wildlife Refuge

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table E.3 summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):
For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

> For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."
>
> For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."
>
> For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in

North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:
"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of migratory waterfowl hunting programs with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is waterfowl hunting. The National Wildlife Refuge System Improvement Act of 1997 identified hunting as one of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the Act encouraged the Service to provide opportunities for these uses.

Background and Rationale for the Management Activity
In the 1930's, when Blackwater Refuge was first established as a refuge for migratory birds, waterfowl hunting in Dorchester County was a means of providing food for the table as well as an accepted popular form of recreation. Most of the area was rural and the local population hunted on their own land and also allowed others to hunt their property. The Blackwater Refuge was considered a sanctuary for wildlife and protected from poachers. Few visitors came to Blackwater Refuge.

A 1949 amendment to the Duck Stamp Act permitted hunting on 25 percent of the lands purchased for the National Wildlife Refuge System with Duck Stamp funds, but Blackwater Refuge remained closed to hunting (Note: Later amendments authorized up to 40%). After World War II, Americans traveled the nations's back roads and discovered their National Wildlife Refuges. Interest developed in using refuges for recreation other than hunting. Although most wanted to share with their families the sights and sounds of wildlife and the wonders of the living world, many citizens wanted to use their refuges to sail, swim, camp, water ski, ride horses, sun bathe, and rock climb. Guidance in the first Refuge Manual (1943) left the door open to uses for the cause of building public support, but conflicts between wildlife and public uses could be forecast. In the 1957 Refuge Manual, guidance on how to decide which public uses to allow hinted towards a wildlife first priority, but sent mixed signals. However, the Refuge Recreation Act of 1962 and the Refuge Administration Act of 1966 placed into law the concept that refuges would be closed to all recreation uses until a manager could determine that a proposed use was compatible with the refuge's establishing purposes and that sufficient funds were available to administer those uses. Refuge managers were responsible for making these compatibility determinations. Decisions were usually made locally, and in many cases, were based on local pressures and interests.

During the CCP scoping meetings, respondents indicated a desire for increased hunting opportunities, including deer, turkey, resident Canada geese, and migratory waterfowl. Resident Canada geese have become a major problem on and off the Refuge.

The Refuge System Administration Act identified hunting as one of the six wildlife-dependent recreational uses to be facilitated in the Refuge System, and the Act encouraged the Service to provide opportunities for these uses.

(B) Where would the use be conducted?
Resident Canada goose hunting blind sites would be located in areas B1, B2, G, F, J, K, L, and O on 3,731 acres of marsh, 70 acres of fields, and 4,500 acres of open water for a total of approximately 8,300 acres. New areas would be evaluated and considered as they are acquired that would not conflict with public use areas; would not adversely affect endangered and threatened species (bald eagle); would not have a negative impact on other wildlife or habitat resources; or adversely affect public safety.

Migratory waterfowl hunting would be conducted along both sides of the upper portion of the Blackwater River from the White Marsh area to Route 16. On the Nanticoke River, migratory waterfowl hunting would be conducted in the area along the east side of the river from Route 50 south to Rewastico Creek.

(C) When would the use be conducted?
Blackwater Refuge would be open to spring hunting (March 15 - April 15) for resident Canada geese according to an Annual Hunt Plan based on the *Integrated Wildlife Damage Management Plan for Control of Resident Canada Geese,* if consistent with the Service Environmental Impact Statement (EIS) on managing these injurious resident waterfowl. The Migratory Bird Treaty Act prohibits hunting of migratory waterfowl after March 15 of each year. Therefore, the Service must prepare an EIS in order to authorize certain conservation measures, including spring hunting of resident Canada geese. Scout days would be authorized the day before each hunt day.

Migratory waterfowl hunting, in accordance with state seasons, species, bag limits, and hunting methods, would be permitted on 40% of all new acquisitions. This proposed hunting opportunity would continue to maintain approximately 23,000 acres as an inviolate sanctuary for wintering and migrating waterfowl.

(D) How would the use be conducted?
Resident Canada goose hunting would require a permit determined by a lottery system issued for 30 blind sites (two people per blind site) constructed by the hunter within 100 yards of a numbered post. Fifteen blinds would be hunted daily. Thirty permits per day (27 days) would be issued providing 810 recreational resident goose hunting opportunities.

Other migratory waterfowl hunting, in accordance with state seasons, species, bag limits, and hunting methods, would be permitted for up to 60 days on up to 40% of all new acquisitions. In addition to all required state and federal permits, all refuge hunters would be required to obtain a non-quota refuge permit.

Migratory waterfowl hunting areas on the upper Blackwater River would be accessible only by boats launched from the Rt.335 launching area. Only canoes, kayaks, and small john boats without trailers are suitable for launching at that facility.

Access to the Nanticoke River waterfowl hunting areas would be by boats launched from the public boat ramp at Vienna.

(E) Why is the use being proposed?
Resident Canada goose hunting is being proposed in order to help reverse the adverse effects this population is having on the primary purpose for which the refuge was established. Complete and detailed analysis of the impacts of resident Canada geese can be found in the *Environmental Assessment for the Management of Conflicts Associated with Non-migratory (resident) Canada Geese* (2000).

The National Wildlife Refuge System Improvement Act of 1997 identified hunting as one of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the act encouraged the Service to provide opportunities for these uses.

Opening additional areas as they are acquired would increase public hunting opportunities at Blackwater Refuge, and eventually the Nanticoke Division. These activities and programs would produce a positive impact on refuge management, visitor attitudes, and local economy. The increase in hunters, especially from other areas like Pennsylvania and Western Maryland would contribute substantially to the economy of the area with their local purchases of gas, food, lodging, hunting licenses, equipment, and supplies. They would spread the word to their friends, encouraging them to come to the area to take advantage of the high quality recreation and thus positively affect the economy of the area.

These proposed hunting opportunities would continue to maintain approximately 23,000 acres as an inviolate sanctuary for wintering and migrating waterfowl while providing quality, compatible, consumptive, wildlife-oriented recreation.

Availability of Resources:
The Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex recommends two full-time law enforcement officers (one at Blackwater and one for the Nanticoke Division) to conduct this and other hunt programs. One full-time officer was hired in FY2003. Combined with the existing two collateral duty refuge officers, there will be sufficient personnel to ensure compliance with regulation, protection of the resources, and public safety when all these positions are filled.

All hunting programs and supporting activities would be totally administered and funded by the Friends of Blackwater, who would also hire and pay for a full-time hunt coordinator. The Hunt Coordinator would administer all aspects of these hunting programs; respond to all questions and provide information to the public; process hunt applications and permits; conduct mailings; provide visitor assistance for the hunt programs; improve customer service; make a positive impression to customers and the public; provide maintenance of signs and parking areas; and otherwise assist hunters in following regulations and enjoying a good hunting experience, all at no cost to the government. Friends of Blackwater will continue to fund the annual publication of regulations, permit applications, maps, and leaflets. Any remaining revenue generated from the administrative process and permit application fees would be used to replace signs, post closed areas, and maintain parking areas and roads.

There should be no significant administration and management costs for the government associated with this specific proposed use.

There would be no special equipment, facilities or improvements necessary to support the amount of hunting anticipated.

Since we would not be putting in any facilities or improvements on refuge property for this specific use, there would be no significant maintenance costs associated with this use.

Monitoring costs associated with maintaining statistical information on hunting activities, kill, age/sex ratios, etc. will be assumed by Friends of Blackwater who will staff the check stations.

Cost Breakdown:
The following is the list of costs to the Refuge required to administer and manage the hunting programs.

Refuge Personnel Costs
Res. Canada goose (27 days@3 hrs/day@$24/hr.)... $1,944
Mig. Waterfowl (60 days@3 hrs/day@$24/hr.)..... $4,320

Total.....$ 6,264

All other costs will be paid for by the Friends of Blackwater.

Anticipated Impacts on Refuge Purpose(s):
The environmental, socioeconomic, and cultural/historical impacts of these programs are thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan, of which this document is an attachment.

Public Review and Comment:
This compatibility determination will be submitted for public review and comment as an appendix to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X_

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
Hunting programs have been conducted for many years and the special regulations, restrictions, and general operations have been structured to ensure compatibility. If the monitoring described under Availability of Resources indicates that this use materially interferes with or detracts from fulfillment of the National Wildlife Refuge System mission or the purposes of the refuge, we would curtail or eliminate the use.

Special Regulations governing our hunting programs will be codified in the Code of Federal Regulations, Title 50 and will be subject to Maryland State regulations and the following special refuge conditions:

1. We require refuge permits for all hunters regardless of age. We require that permits must be in the hunter's possession along with a valid Maryland State hunting license, any required stamps, and a photo identification. Permits are non-transferable.

2. We require that hunt permits be obtained only through the mail by mailing an application and administration fee to the refuge after applications are made available. To obtain an application and regulations leaflet, including designated areas and map, dates of hunts, bag limits, and permit fees, we require hunters to contact the refuge hunt coordinator or refuge Visitor Center between the hours of 9:00 am and 4:00 pm daily.

3. We allow only participants possessing authorized permits to enter the hunt areas.

4. We require check-in for all hunts beginning at 5:00 am.

5. We do not require check-in or check out at the refuge for the hunts.

6. We require only weapons that meet Maryland State regulations.

7. We allow access to hunt areas only on designated roads and parking areas indicated on hunt maps in the regulations leaflet (obtained with application by mail or at the Visitor Center). All other access is limited to walk-in or bicycles.

8. We allow scouting only on designated days listed in the regulations for permitted hunters.

9. We do not require check-in or check-out for scouting.

10. We do not allow firearms or other weapons on the refuge when scouting.

11. We require permitted youth hunters to be accompanied by permitted adult age 21 or older while scouting.

12. We do not allow pets in hunt areas.

13. We do not allow hunting from or shooting across a roadway where vehicle traffic is allowed.

14. We do not allow commercialized guiding.

Justification:
Migratory waterfowl hunting will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

The Migratory Bird Conservation Act of 1929, which established inviolate sanctuaries, was amended by the National Wildlife Refuge System Administration Act of 1966. This amendment authorized up to 40 percent of an area acquired for a migratory bird sanctuary to be opened to migratory bird hunting. Migratory waterfowl hunting, in accordance with state seasons, species, bag limits, and hunting methods, would be permitted on 40% of all new acquisitions. This proposed hunting opportunity would continue to maintain approximately 23,000 acres as an inviolate sanctuary for wintering and migrating waterfowl.

The National Wildlife Refuge System Improvement Act of 1997 identified hunting as one of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the act encourages the Service to provide opportunities for these uses.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 15 year Reevaluation Date: June 26, 2021

Attachment

Table E.3. Land Acquisition History

References:

Belanger, L. and J. Bedard. 1989. Responses of staging greater snow geese to human disturbance. J. Wildl. Manage. 53(3):713-719.

Cullen, R. 1985. Rationing recreational Use of public land. J. Environ. Manage. 21: 213 - 224.

Keller, V. E. 1991. The effects of disturbance from roads on the distribution of feeding sites of geese (Anser brachyrhynchus, A. anser), wintering in north-east Scotland. Ardea 79:229-232.

Klein, M. L. 1989. Effects of high levels of human visitation on foraging waterbirds at J. N. "Ding" Darling NWR, Sanibel, FL. Final report to USFWS. 103 pp.

Laskowski, H., T. Leger, J. Gallegos, and J. James. 1993. Behavior response of greater yellowlegs, snowy egrets, and mallards to human disturbance at Back Bay National Wildlife Refuge, Virginia. USFWS, Final report RMS 51510-01-92. Cambridge, MD. 31 pp.

McNeil, R., P. Drapeau, and J. D. Goss-Custard. 1992. The occurrence and adaptive significance of nocturnal habits in waterfowl. Biol. Rev. 67:381-419.

Morton, J. M. 1987. Habitat use and energetics of American black ducks wintering atChincoteague, Virginia. M.S. Thesis. VPI&SU, Blacksburg, VA. 147 pp.

Paulus, S. L. 1984. Activity budgets of nonbreeding gadwalls in Louisiana. J. Wildl.Manage. 48(2):371-380.

Purdy, K. G., G. R. Goff, D. J. Decker, G. A. Pomerantz, and N. A. Connelly. 1987.A guide to managing human activity on National Wildlife Refuges. Human Dimensions Research Unit, Cornell Univ., Ithaca, NY. 34 pp.

U.S. Department of the Interior, Fish and Wildlife Service. 2000. Hunt Management Plan. Blackwater National Wildlife Refuge, Cambridge, MD. 8 pp.

Table E.3. Land acquisition history (Blackwater NWR)

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
1/13/33	18	1.00	Graveyard Tract	MBCA
1/13/33	19	72.00	Blackwater R.	MBCA
1/23/33	14,a,-I,-II,-III,b–g,i	8,167.99	Delmarvia Fur Farms	MBCA
12/01/42	16,a	355.18	Kuehnle	MBCA
8/02/45	24,a–c	2,203.21	Seward	MBCA
4/21/51	29	416.94	Smith	MBCA
6/22/72	37	408.40	Luthy	MBCA
6/23/72	38	1.15	Brooks	MBCA
6/29/72	31	1.28	Turner	MBCA
6/27/75	45,R	175.10	Spicer	ESA
5/15/78	45b–d	1,610.47	Jarrett	ESA
9/28/78	45a–e	852.84	Jarrett	ESA
10/09/84	58,-I	489.50	Handley	ESA
4/19/85	53,-I	863.00	Herman Robbins Est.	MBCA
4/20/64	41,R	0.00	State of MD Easement	MBCA
11/05/76	2	7.14	State of MD Exchange2	80 STAT. 926
3/02/77	14d	(9.89)	State of MD Exchange3	16 U.S.C. 668dd
8/11/87	54	71.40	Schmidt	RRA
10/21/87	55,-I	237.20	Wm. Robbins	RRA
11/02/88	99,R	445.00	Paul Handley Est.	MBCA
11/09/88	52	297.20	Rufus Robbins	MBCA
4/09/91	100	454.20	Pascal	MBCA
10/21/91	51,-I	562.70	Gregg	MBCA
12/24/91	100a–i	176.75	Barren Island	MBCA
12/30/92	101	797.78	Williams	MBCA
12/28/92	100m	459.47	Howard	RAA
12/30/92	100j	380.00	Bishops Head	RAA
12/30/92	100k	52.00	Spring Island	RAA
2/28/94	100n	856.00	Madison (Ewing)	NAWCA

Date	*Tract No.*	*Acres*	*Tract Name*	*Authority*[1]
8/10/94	59	201.00	Mills	MBCA
11/2/94	103	299.95	Burton	MBCA
2/7/96	100t	173.85	Elliott	MBCA
12/28/95	104a	324.34	Valiant	MBCA
5/23/96	100r	55.23	Rasche	MBCA
8/6/96	100u	1,163.06	Linthicum	MBCA
7/29/96	100p,q	431.26	Lakes	MBCA
12/16/97	100Ae	149.73	Williamson	MBCA
9/24/99	108	74.88	Spicer	MBCA
9/24/99	107r	748.26	Spicer	MBCA
7/26/99	100Af	26.50	Long	MBCA
3/29/99	105,a	174.48	LeCompte	MBCA
3/28/00	100Ag	64.73	Riggins	MBCA
6/29/72	31	1.28	Turner	MBCA
3/15/00	54a	141.60	Schmidt	MBCA
2/6/02	100Ah	109.81	Newcomb	MBCA
2/20/02	100Ai	89.25	Newcomb	MBCA
6/26/93	102	0.11	Wooten	MBCA
7/8/00	106	149.06	Stanley	MBCA
6/28/00	111	139.10	Elliott	MBCA
1/4/00	113	215.80	Lewis	MBCA

[1]MBCA: Migratory Bird Conservation Act; ESA: Endangered Species Act; RRA: Refuge Recreation Act; NAWCA: North American Wetlands Conservation Act; RAA: Refuge Administration Act

[2]Received in an exchange with the State of Maryland for land of equal value

[3]Given in an exchange with the State of Maryland for land of equal value

COMPATIBILITY DETERMINATION

Use: Wildlife Observation, Photography, Interpretation, and Environmental Education

Station Name: Blackwater National Wildlife Refuge

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The first and largest of these areas to be established was Blackwater NWR. Originally authorized for establishment by the Migratory Bird Conservation Commission on December 3, 1931, and named "Blackwater Migratory Bird Refuge," the refuge's current 28,000 acres are a showplace for the U.S. Fish and Wildlife Service's Refuge System.

On December 31, 1931, the Migratory Bird Conservation Commission authorized the Secretary of Agriculture to purchase 10,000 acres from the Delmarvia Fur Farms, Inc. of Philadelphia, Pennsylvania. On December 9, 1931, the Secretary entered into an agreement with Delmarvia Fur Farms, Inc., effective January 1, 1932, to lease 8,167.99 acres for the refuge. The Secretary subsequently determined that it was in the best interest of the Government to acquire 8,240.99 acres for the refuge from the Delmarvia Fur Farms and two other properties by condemnation. A notice of condemnation was filed August 26, 1932, and these tracts were conveyed to the Government in January 1933.

Blackwater NWR was therefore officially established under the authority of the Migratory Bird Conservation Act on January 23, 1933. Since that time, additional lands have been added to the refuge under the authorities of the Endangered Species Act, Refuge Recreation Act, North American Wetlands Conservation Act, and the Refuge Administration Act.

Table I summarizes Blackwater National Wildlife Refuge's acquisition history and the tracts that are currently being affected by the proposed uses. Unless otherwise noted, all acquisitions are fee title. This compatibility determination will also apply to additional tracts, particularly those in Blackwater's Nanticoke Division, as they are acquired.

Refuge Purpose(s):

> For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."
>
> For lands acquired under the Endangered Species Act of 1973 (16 U.S.C. § 1534), the purpose of the acquisition is "...to conserve (A) fish or wildlife which are listed as endangered or threatened species...or (B) plants."
>
> For lands acquired under the Refuge Recreation Act (16 U.S.C. § 460K-1), the purpose of the acquisition is for "...(1) incidental fish and wildlife-oriented recreation; (2) the protection of natural resources; (3) the conservation of endangered species or threatened species..."
>
> For lands acquired under the North American Wetlands Conservation Act (16 U.S.C. § 4401-413), the purpose of the acquisition is "(1) to protect, enhance, restore, and manage an appropriate

distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distribution of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

For lands acquired under the Refuge Administration Act (16 U.S.C. § 668ddb), the purpose of the donation is "to protect, enhance, restore, and manage wetland ecosystems and other habitats for migratory birds, endangered and threatened species, and other wildlife."

National Wildlife Refuge System Mission:
"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of wildlife observation, photography, interpretation, and environmental education with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is wildlife observation (biking, walking, hiking), photography, interpretation, and environmental education. The National Wildlife Refuge System Improvement Act of 1997 identified wildlife observation, photography, interpretation, and environmental education as four of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the Act encouraged the Service to provide opportunities for these uses.

Background and Rationale for the Management Activity
In the 1930's when Blackwater NWR was first established as a refuge for migratory birds, the refuge was considered a sanctuary for wildlife. Few visitors came to the refuge. By the 1960's, people began to take an interest in Blackwater for recreation. Schools began to bring students to see wildlife, visitors interrupted working employees to ask questions, and people wanted a place to picnic in a natural setting. A recreational area (consisting of a shelter, rest room, picnic area with tables, charcoal cookers, walkways, and parking area) was constructed in 1963. The area was highly sought after and appreciated by local residents as it was the only facility maintained in the entire county. It is still only one of the few, if any, public use areas available in Dorchester County. Photographers and bird watchers continued to increase with the pressure of their use being felt by the refuge staff. A Visitor Center was constructed in 1996. Locally, the new Center was called the Community Center where people of the surrounding area could go to ask questions and learn about their renewable resource - wildlife. With the continued demand for wildlife oriented recreation along with the increase in visitation, additional facilities were constructed: an observation tower in 1968, a 2 ½ mile Wildlife Drive in 1969, and 2 walking trails in 1971. A self service entrance Fee Program, begun in 1987, caused an initial drop in visitation, but was gradually accepted by the local population continuing the increase in visitation. Four kiosks with interpretive panels were completed in 1999. Public demand for information prompted the refuge to produce a general leaflet; bird, mammal, reptile and amphibians check list; Canada goose leaflet, and Wildlife Drive and Marsh Edge Trail guides. Blackwater became a showcase for wildlife. It was a place for adults and children to learn first hand nature's lessons of adaptation and diversity to see birds and wildlife in their natural environment, and to pass on to a new generation a love for America's wildlife. Visitation peaked in 1999 at approximately 500,000, with 100,000 using refuge facilities and programs.

In the 1960's, the entire staff participated in the overall refuge interpretive program. Although well-trained and equipped to manage habitat and wildlife, the staff faced new challenges with the task of managing an

eager and active public. The idea took hold that a better informed public could be a positive force in shaping conservation awareness, and thus policy and practice. A Public Use Specialist was hired in 1968 increasing the number of environmental and interpretive programs. Visitation continued to increase and required a permanent full time Outdoor Recreation Planner (ORP), a permanent full time Recreation Assistant, and as many as 2 temporary and 2 seasonal Recreation Assistants. Since1990, when both the ORP and Recreation Assistant took other positions, Blackwater has had only one ORP and numerous temporary Recreation Assistants, volunteer interns, or Student Conservation Association Volunteers (usually only one at a time for 3 month periods requiring a great deal of time for recruiting and training). There were also periods as long as 6 months when the ORP tried to cope with the increasing demand of a Public Use Program with only the assistance of volunteers. It is no longer possible to keep up with the expectations and requests of the public without additional staff.

Although there were a few citizens starting to volunteer in 1981, volunteer workshops weren't started until 1985. The program reached 104 volunteers in 1994 and has remained consistent with approximately 100 volunteers providing over 11,500 hours/ year of their time. The Visitor Center is staffed mainly by volunteers and sometimes are the only ones on the refuge because of the staff shortage. The Friends of Blackwater (FOB), a cooperative association that established a book store in the Visitor Center in 1988, has grown to an organization of over 700 members, grossed over $61,000 in their bookstore in 1999, procured several grants to assist in refuge projects, and has become nationally known for their mentoring and assistance in developing other "friends" groups. FOB has supported the Public Use Program by helping to offset the shortage in staffing and government funding, and has assisted the refuge in trying to meet the public demand for environmental and interpretive programs.

During the scoping meetings, the public expressed their desire for more facilities and public use of the refuge. In particular, they want increased opportunity for wildlife-oriented educational and interpretive programs, more opportunities for local school use and education, better auto tour routes, more hiking trails, canoe trials and maps, boat ramps, bike trails, observation tower, and a remodeled/new Visitor Center. Although the Visitor Center exhibits were upgraded in 1982, they are in need of new, updated, and innovative displays to better inform the public of Service and Blackwater Refuge policies, wildlife needs, and awareness of wildlife conservation.

Proposed strategies include increasing environmental education programs (including the publication of an environmental education manual); increasing the number and types of interpretive and outreach programs, photographing facilities, and wildlife observation facilities; constructing an environmental education facility; updating exhibits and remodeling and enlarging the existing Visitor Center; and hiring more staff to plan, manage, conduct, and operate the public use program.

.

(B) Where would the use be conducted?

Wildlife observation, photography, interpretation, and environmental education will all occur on the five-mile Wildlife Drive, the .3 mile Marsh Edge Trail and the .5 mile Woods Trail on Tract 14a; other forested and wetland areas of Tract 14, Tract 52, Tract 37, Tract 45e, Tract 45c, Tract 100ai, Tract 100ah; upland areas of Tracts 100 and 101 as designated by the refuge on request; and proposed acquisition of the Robbins property (approximately 19 acres) located adjacent to Tract 14.

The Wildlife Drive begins at the old refuge office (across the road from the fire building) on Key Wallace Drive and extends south across the Pool 1 dike to the Marsh Edge Trail and the observation site, and/or turns west after crossing the Pool 1 dike, and continues along the southernmost dikes of Pools 1, 3, and 5 until it exits onto State Route 335, an area of approximately 10.08 acres. The area was first established as the Wildlife Drive over 45 years ago because the dike system that created the freshwater impoundments represented a "ready-made" infrastructure, the only real interior infrastructure that could be considered for such use. Even today, there is no other location more suited for a wildlife drive in terms of infrastructure, and certainly there is no other location that gives the visitor a representation of all refuge habitats within such a short distance, yet restricts use to only 10.08 acres of the refuge's 23,444 acres.

The Marsh Edge Trail begins at the environmental education pavilion parking area, and extends through approximately 10 acres of loblolly pine woods to the marsh where it connects to a 40 foot observation deck that is constructed along the edge of the Little Blackwater River. The Marsh Edge Trail is paved to accommodate handicapped access. Uses will be restricted to the 6' wide paved area and to the boardwalk, a total area of approximately .2 acres.

The Woods Trail begins at a parking lot along the Wildlife Drive, and extends in a .5 mile loop through the center of 50 acres of loblolly pine woods. Uses will be restricted to the chipped trail, an area of approximately .3 acres.

The trails were first established as the Marsh Edge Trail and Woods Trail over 25 years ago. They were originally constructed with minimal disturbance of the habitats within the already existing Wildlife Drive area. With the exception of improvements made for wheelchair access (paving) and interpretation/education (signing and numbered stops), the trails have not changed. The trails provide a sample of the refuge's diverse habitats for interpretation and education, yet directly impact only .5 acres of the refuge's 23,444 acres.

The proposed new Key Wallace Trail, habitat demonstration area, and environmental education facility will be located on Tract 37 across from the headquarters building. The 2.7 mile trail will begin at the intersection of Key Wallace Drive and Egypt Road, cross through a previously harvested immature forest area, follow an existing road that goes by two ponds, and continue through a mature forest area. Boardwalks, photo blind, observation platform, outdoor classroom pavilion, and a 20' x 20' storage facility will be located in open fields near the ponds. The outdoor classroom facility will consist of a covered 25' x 40' pole pavilion with cement floor and six weatherproof tables and benches to seat thirty-six students comfortably. The trail and associated facilities will provide various stages of a forest for wildlife observation, photography, interpretation, and education yet directly impact only 5 acres.

The proposed new 1.7 mile White Marsh Trail will be located on Tracts 100ai and 100ah. The trail will be accessed from Hip Roof Road and will follow existing roads. The trail will circle through a wetland forest area impacting 2 acres. Some of the area will be reforested to restore tornado damage, while a small area will be left for visitors to see the results of a tornado and natural regeneration following the disaster.

The two new proposed trails take advantage of cleared firebreaks and roadways for part of the trail experience. The portions of the trails that pass through undisturbed forest and field will be “blazed” trails. That is, there will be no parts of the trails that are not on the old firebreaks that will be man made. There will be no “bush hogging” or “cutting in” the trails. A visitor will experience the forests and fields as they are in nature, without man made interference. Each trail head will begin at an existing parking area of crushed stone and will include an information kiosk, numbered trail signs, and map/brochure guide.
A third new proposed Gum Swamp Trail, kiosk, observation/photo blind, and parking area will take advantage of existing roads and parking area with minor physical impact on the surrounding forested habitat. This trail will extend from Route 335 to Smithfield Road though Tracts 45e, 45c, and 100ah. The trail would be approximately 5 miles long and connect with the proposed White Marsh Trail.

A new 200' x 8' accessible boardwalk and 20' x 20' elevated observation platform will be constructed at the old observation tower site along the Wildlife Drive at the junction of the Little Blackwater River and Blackwater River. The structure would replace the observation tower removed in 1990.

Two new wheel chair accessible photo blinds will be constructed along the Wildlife Drive on Tract 14a. The first 10' x 16' blind with an 80' x 6' boardwalk will overlook a small pond adjacent to a wooded area. The second blind will be constructed at the beginning of the pool 5 section of the Wildlife Drive which will eventually be converted to non-motorized use. The entrance to the Wildlife Drive will be redesigned to allow visitors to enter the Wildlife Drive from the Visitor Center. The original first section of the drive (pool 1 and pool 3) will be for motorized vehicles exiting at the original entrance, and the second section (pool 5)

will be a safe observation area for non-motorized use. The second loop will connect with a bike trail to be constructed by the Maryland Highway Department and Dorchester County along Route 335 to Hip Roof Road, providing a four to five mile bike trail.

An environmental education outdoor classroom and parking area will be constructed in the site of a previous residence which burned to the ground and would minimize physical and biological impacts to the environment. The Service will purchase the Robbins property located east of Key Wallace Drive near the Visitor Center. The site will utilities available from the previous burned residence requiring no additional excavation or disturbance reducing the cost of construction. The outdoor classroom will provide storage, wet laboratory, and working tables and chairs for up to 75 students.

The new proposed administrative facility/visitor center/environmental education site at the Nanticoke Division will be located in prior disturbed habitat. There are several opportunities for siting the facility on properties that have been cleared and previously disturbed by construction. The proposed trail and observation tower for the Nanticoke Division will be located in an area that will least disturb the wildlife and habitat by taking advantage of existing roads if possible.

(C) When would the use be conducted?
Wildlife observation and photography will be conducted on the Wildlife Drive and trails daily, year-round, from dawn to dusk (i.e., daylight hours only), unless there is a conflict with a management activity or extenuating circumstance that would necessitate deviations from these procedures. Closures for ice storms or other events affecting human safety or activities needed to protect a newly constructed eagle nest are examples that would require these uses to be temporarily suspended. Use will be further restricted by weather and summer insect infestations, self limiting factors that virtually eliminate all uses during June through August in some areas.

(D) How would the use be conducted?
Utilization of the Wildlife Drive will be authorized for automobiles and other motorized vehicles, bicycles, and pedestrians who simply want to walk/hike. All uses will be expressly restricted to the paved roadway, boardwalks, observation/photo blinds, and paved or chipped trails. Admission to the Wildlife Drive, Marsh Edge Trail, Woods Trail, and photo blinds will be regulated by an electric gate at a "self-serve" entrance fee station that will be administered according to provisions in 50 CFR, Subchapter C, Part 25. Educational groups may request a fee waiver for utilization of the Wildlife Drive and associated hiking trails and facilities.

The uses described above will be regulated by signing and distribution of publications and regulations at the entrance station (posting Prohibited/Permitted signing, posting time of day use is authorized, 15 m.p.h. maximum speed limit signing, caution signs for recognition of endangered species and waterfowl which may cross the roadway, maps and interpreted information, teacher workshops, and distribution of refuge leaflets and Wildlife Drive and Marsh Edge Trail Guides with numbered, interpreted stops corresponding to signing). A guide/map with numbered, interpreted stops corresponding to signing is planned for other trails. Law enforcement patrols and compliance checks by refuge officers will be used to enforce the provisions of 50 CFR, Subchapter C, Parts 25, 26, and 27, as applicable. As previously mentioned, Staff and volunteers at the Visitor Center and the refuge office will also give instructions to visitors on how these uses are to be conducted.

Utilization of outdoor classrooms, forested and wetland areas on the trails, observation site, and limited specific wetland, wet forest, upland forest and grassland sites in other areas of the refuge will be authorized for educational outdoor classroom activities on an individual basis. These uses will be regulated by refuge personnel personally instructing qualified teachers on how and where the activity will be conducted. Approximately 99% of the activities will be conducted in areas where refuge personnel conduct similar educational and interpretive activities designated in the Public Use and Management Plans and are incorporated in teacher workshops.

(E) Why is the use being proposed?
These uses will be conducted to provide compatible educational and recreational opportunities for visitors to enjoy the resource and to gain understanding and appreciation for fish and wildlife, wildlands ecology and the relationships of plant and animal populations within the ecosystem, and wildlife management. They will enhance the public's understanding of natural resource management programs and ecological concepts to enable the public to better understand the problems facing our wildlife/wildlands resources, to realize what effect the public has on wildlife resources, to learn about the Service's role in conservation, to better understand the biological facts upon which Service management programs are based, and to foster an appreciation as to why wildlife and wildlands are important to them. The authorization of these uses will produce a more informed public, and advocates for Service programs. Likewise, these uses will provide opportunities for visitors to observe and learn about wildlife and wildlands at their own pace in an unstructured environment and to observe wildlife habitats firsthand. Professional and amateur photographers will also be provided opportunities to photograph wildlife in their natural habitats. Photographic opportunities obviously will result in increased publicity and advocacy for Service programs. These uses will also provide wholesome, safe, outdoor recreation in a scenic setting, with the realization that those who come strictly for recreational enjoyment will be enticed to participate in the more educational facets of the public use program, and can then become advocates for the refuge and the Service.

Availability of Resources:
Requested additional staff will develop and conduct more environmental education programs for different age groups, types of groups (including scouts, 4-H, college, adults, etc.) and for larger numbers of groups; develop an Envirothon for middle and elementary schools; develop communication workshops and meetings with other environmental education organizations and institutions; hold teacher workshops; recruit and train more volunteers; prepare and present more interpretive programs; develop a new updated video; revise leaflets and develop new ones; update kiosk information; develop needed signs; catalog and store slides, photos, and historical items; develop habitat demonstration areas and trails; plan and conduct photography programs; organize and conduct more events; regularly schedule programs for the public; work with Dorchester County Tourism, Harriet Tubman Organization, National Park Service, Gateways Program and other organizations to plan events and activities; display off-site exhibits at more local events; develop ecotourism with the Hyatt and Dorchester County Tourism; participate in the development of watershed-wide cooperative outreach groups; develop better relationships with media providing monthly reports; and be able to respond immediately to public inquiries.

Staff at the Nanticoke Division will be required to initiate, plan, develop, and conduct an interpretive and environmental education program, staff a visitor center, and to develop visitor center exhibits, leaflets, signs, video, website, and special events. The staff will develop teacher workshops, a volunteer program, off-site exhibits and ecotourism programs. They will introduce the Nanticoke Division to the public, the media, and participate in local events and activities. They will plan and develop trails and other observation facilities.

Cost Breakdown:
The following is the list of costs to the refuge required to administer and manage wildlife observation, photography, interpretation, and environmental education programs.

<u>Yearly Service Staffing Costs</u> - Blackwater NWR
Outdoor Recreation Planner GS-0023-12/13.....$ 87,285
Outdoor Recreation Planner GS-0023-9/11.....$ 61,253
Park Ranger GS-0025-5/7.....$ 41,379
Park Ranger (LE) GS-0025-5/7.....$ 41,379
Total.....$ 231,296

Facility and Equipment Costs - Blackwater NWR
Redesign Wildlife Drive, Signs & Kiosks.....$ 180,000
3 photo blinds, observation platform & 15 miles hiking trails.....$ 106,000
EE Manual.....$ 85,000
Exhibits, outreach & materials for folk museum.....$ 124,000
Construct observation platform & 150' environmental ed boardwalk.....$ 252,000
Remodel Visitor Center.....$ 1,000,000
Construct environmental outdoor classroom ..... $ 250,000
Install Traveler's Station.....$ 38,000

Total..... ... $ 2,035,000

Non-Service Costs Provided by Partnerships, Grants, and Donations - Blackwater
Traveler's Station - Dorchester County.....$ 3,000

Yearly Service Staffing Costs - Nanticoke Division
Outdoor Recreation Planner GS-0023-9/11.....$ 61,253
SCEP GS-0499-5/7 .....$ 20,689
Park Ranger (LE) GS-0025-5/7.....$ 41,000
Maintenance Worker WG-4749-08.....$ 50,000

Total.....$ 173,942

Facility and Equipment Costs -Naticoke
Needs and location assessment for building construction, trails, etc.....$ 95,000
Construct Visitor Center/Administration/ EE Building.....$ 1,000,000
Equipment & materials to implement Environmental Education Program.....$ 26,000
Interpretive & educational exhibits, signs, video, leaflets, website & kiosk.....$ 430,000
Install traveler's station, off-site exhibits, and 2 public event supplies.....$ 35,000
Wildlife observation trail and tower..... $ 113,000

Total.....$1,699,000

Anticipated Impacts on Refuge Purpose(s):
The following is a summary of the environmental, socioeconomic, and cultural/historical impacts of these programs as more thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment.

Physical Impacts: Uses of the Wildlife Drive will directly impact approximately 10.08 acres of refuge habitat, i.e. the tops of dikes and/or access roadways to these dike systems that were constructed primarily for migratory bird management purposes and administration (creation and management of freshwater impoundments and croplands, and access to the residences and maintenance area). These uses therefore directly impact less than .05% of the total refuge acreage that supports this particular purpose. It should be noted that even if the subject uses were eliminated, refuge management and administrative uses of these acres would not change, i.e., the roadway would remain paved and the dikes would continue to be maintained just as they currently are to support migratory bird management purposes. There is no other direct impact to habitats since visitors are restricted to the pavement.

Uses of the existing trails will directly impact approximately .5 acre of refuge habitat that is used primarily by migratory songbirds, and to a lesser degree, a few shorebirds and marsh and water birds near the boardwalk at the Marsh Edge Trail. Being primarily forested areas, trail habitats do not support large numbers of other migratory birds such as waterfowl. These uses therefore directly impact less than .003%

of the total refuge acreage that supports this particular purpose. There is no other direct impact to habitats since visitors are restricted to the paved or chipped areas.

A maximum of 550 students (usually in small groups of 20 a program) a year participate in environmental education workshops in areas other than on the paved drive and Marsh Edge Trail or the Chipped Woods Trail. Approximately 90% of these have been refuge interpreted programs that are part of the Public Use and Management Plan. The remaining 55 students use the refuge different times of the year, in 5 different areas, and in such small groups as to not have an impact on the habitat.

Construction of visitor centers and environmental education outdoor classrooms will occur in prior disturbed habitats. There are several opportunities for siting the administrative facility and visitor center at Nanticoke Division on properties that have been cleared and previously disturbed by construction. At Blackwater Refuge, the Visitor Center expansion and remodeling would occur within close proximity to the existing footprint, in open agricultural fields requiring no clearing of trees or vegetation, and in areas previously disturbed by a historical CCC camp. Blackwater Refuge's environmental education outdoor classroom, proposed for siting on the Robbins Property, would be constructed within the footprint of a private residence that recently burned. The site has already been disturbed, and utilities exist, thus requiring no additional excavation or disturbance.

During construction activities, best maintenance practices and storm water runoff/sedimentation plans would be implemented to minimize erosion or degradation to water quality. The additional observation trails at Blackwater Refuge that would extend through a habitat demonstration area off Key Wallace Drive, through a tornado damaged area off Hip Roof Road, and from Route 335 to Smithville Road, would simply utilize existing roadways and dikes constructed in the 1970's. The proposed trail and observation tower at the Nanticoke Division would also utilize existing roadways when possible. Overall, physical impacts should be very minimal.

Biological Impacts: At Blackwater Refuge, public use can potentially interfere with normal migratory bird and other wildlife habits in several ways. One is the disruption of normal foraging and social behavior of wildlife by feeding (Edington and Edington, 1986). Van der Zande (1980) defined such disturbance as "emission of stimuli to which animals may respond by avoiding the vicinity...". Several studies have also found correlations between human-use levels and bird densities (Erwin, 1980; Madsen, 1985; Werschkul et al, 1976.) High levels of disturbance may keep ducks from building up enough energy reserves over the winter to meet subsequent reproductive requirements (Hohman et al, 1988). Pair-bonding may likewise be adversely affected when disturbance is high (Anderson et al, 1988). In addition, the effects of common human actions, including specific recreational activities, have been examined by Burger (1981, 1986) and Vos et al (1985), and these actions can, at certain levels, influence a wide diversity of migratory waterbirds (Klein, 1989).

The concern, therefore, is whether or not these disturbances are sufficient to adversely affect the subject purpose(s) for which the refuge was established. Several major evaluation criteria will be used to make this determination: percentage of the refuge's habitats affected; the number of visitors; location of the wildlife drive and associated trails and their juxtaposition to important habitats; types of human behavior (treatments) and the types of activities visitors participate in; timing of visitation; importance of visitation area to migratory birds; species composition; enforcement and education; presence of "escape cover;" and location of high-quality foraging areas in relationship to line of sight from the wildlife drive and trails.

Even on the best days, only 25% of the Wildlife Drive visitors use the Marsh Edge Trail, and only 17% use the Woods Trail (information obtained from visitor surveys). This equates to peak visitation of approximately 100 and 72 people for daily weekend use, respectively. Peak weekday use is 22 and 15 visits, respectively. However, peak visitation occurs only four months a year (April, May, October, and November) when weather conditions are the best and the insect populations are still bearable. Visitation in other months is considerably less or almost nonexistent as in June, July, and August. The maximum number of

student/teacher workshops is only 130 with a maximum of 4200 students. There are approximately 60 non-staff conducted programs with approximately 1400 students held each year.

Assuming a zone of visitors influence of 50 feet on either side of the trails in these forested areas, the maximum area of human disturbance along the two hiking trails that could be expected from these uses would be approximately 9.6 acres or less than .05% of the total refuge acreage managed for the purposes of migratory birds.

Given the critical distance of 80 meters (the greatest distance that similar migratory bird species were not as likely to be disturbed by the same types of uses being proposed) described for J.N. "Ding" Darling NWR's 8 km wildlife drive (Klein, 1989), the maximum area of human disturbance along the 5-mile Wildlife Drive that could be expected from these uses would be approximately 300 acres or only less than 1.5 percent of the total refuge acreage managed for the purposes of migratory birds.

The potential for disturbance at Blackwater, however, is significantly less than at "Ding" Darling Refuge, for several very important reasons: 1) Overall annual visitation at Blackwater Refuge is almost five times less (approx. 120,000 at Blackwater Refuge vs. 538,000 at "Ding" Darling Refuge) and, equally important, the average daily use is considerably less (35 vehicles per week day at Blackwater Refuge vs. 350 vehicles per week day at "Ding" Darling Refuge). Peak use is also considerably different (170 vehicles per weekend day during peak season, 50 during summer at Blackwater Refuge vs. 600 vehicles per weekend day during peak season, 425 during non-peak season) at "Ding" Darling Refuge); 2) Blackwater Refuge is four times larger than "Ding" Darling Refuge (8500 ha vs. 2030 ha), with significantly more migratory bird habitats (Carowan, 1994); 3) The impoundment system at Blackwater Refuge has a new series of contour, subimpoundment dikes that parallel the Wildlife Drive that screen foraging/resting migratory water birds from visitors, thereby decreasing disturbance; 4) Alternative, closely adjoining, extremely high quality, migratory bird feeding/resting habitats have been acquired and developed at Blackwater Refuge in areas where no public use is authorized; 5) At Blackwater Refuge, 75% of the visitors are contacted at the Visitor Center where visitors receive much more individual attention than at "Ding" Darling Refuge where visitation exceeds the ability of staff and volunteers to successfully interact with visitors (Klein, 1989). Approximately 99.9% of the teachers giving workshops at Blackwater Refuge have received training and/or individual instruction from refuge staff; 6) The majority of feeding and foraging habitats at "Ding" Darling Refuge are within sight of the Wildlife Drive, and the majority of the waterbirds are required to feed at relatively narrow time windows (Klein, 1989) dictated by tidal cycles, situations that do not exist at Blackwater Refuge; 7) Most public use occurs from 9:00 a.m. to 5:00 p.m. at Blackwater Refuge, periods when most migratory birds are less active, although time of day and weather conditions are less important in determining harmful disturbances than conditions mentioned in #6 (Chapman, 1984); and 8) The majority (80%) of student/teacher environmental education programs and all other visitors at Blackwater Refuge are restricted to the roadway, and therefore the major form of disturbances determined by Klein (1989) (i.e., approaching wildlife on foot and exploring off the roadway) are not as likely to affect migratory birds at Blackwater Refuge. In addition, extensive, alternative (if so desired), extremely high quality, migratory bird feeding/resting/nesting habitats have been acquired and developed at Blackwater Refuge in areas where no public use is authorized, and the locations of the trails are not in habitats of major importance to migratory birds.

Additional facilities would result in moderate disturbance to wildlife while under construction. These impacts would be short lived and should not significantly affect Federal trust resource species in the long-term. The photo blinds may negatively impact a few wildlife while being constructed, but should have little or no impact on wildlife and their habitats after construction. These facilities would be sited to avoid endangered species habitats and sensitive areas. After construction, the photo blinds would actually help to minimize disturbance by focusing photographic opportunities on specific areas where photographers are out of view of wildlife and where they are not as likely to wander into sensitive areas. Impacts attributable to environmental education and interpretation would be mitigated by the benefits of educating the public about refuge resources and the environment.

Obviously, with improved facilities, there would be increased visitation. Disturbance, however, would remain minimal overall since most of the these public use facilities already exist, and they would, for the most part, continue to be located on a very small portion (less than 4%) of the total refuge's acreage. Also, the expanded activities would occur in areas where wildlife have habituated to human activities over the course of over a half century. On Blackwater Refuge, for example, excluding the new observation trails on Key Wallace Drive and Hip Roof Road, all the public use would occur on about 1,000 acres of the refuge's more than 23,444 acres. The same overall effects would be predicted for the Nanticoke Division.

Socioeconomic Impacts: A remodeled Visitor Center at Blackwater Refuge with new exhibits, Environmental Education Outdoor Classroom, and increased number of activities, materials, and facilities would reach a much greater segment of the public with up-to-date information that promotes Blackwater Refuge and Service mission and goals and can create support for wildlife both on and off Blackwater Refuge. As facilities are enhanced, the possibilities for a quality experience are enhanced. As more people enjoy quality experiences, visitation would increase. Thus, the communities surrounding Blackwater Refuge would benefit through increased use of their facilities, service stations, lodging, and restaurants.

Providing a well staffed Visitor Center on the Nanticoke Division that has the potential to reach over 6 million visitors a year; publishing a Nanticoke Division film, interpretive tour guides and informative leaflets; providing proper signing; printing maps and brochures that convey the mission and goals of the Nanticoke Division and provide understanding of the Nanticoke Division and Nanticoke Division management, would reduce potential conflicts while educating a more knowledgeable public. Working with the community, community organizations, tourism, schools, local businesses, news media, congressional entities, constituent groups, and state and local government agencies to develop programs, events, and activities, would only increase the good association with the community and help establish a better understanding of the Nanticoke Division, its mission and goals, wildlife, and wildlife habitats. Interest in wildlife observation by walking, biking, canoeing, and automobile, and photographing wildlife, has been steadily increasing. With increased opportunities for wildlife observation at Nanticoke Division, more facilities are provided, and better relationships with the community are developed, more visitors would come to the Nanticoke Division. The communities surrounding the Nanticoke Division would benefit from increased use of their service stations, facilities, lodging, and restaurants. If the current $15 million a year in benefits to the local economy are any indication of what can be expected at the Nanticoke Division, these activities would significantly increase the potential for ecotourism related businesses.

Dorchester, Wicomico, and Somerset Counties are developing Tourism Management Plans that will increase and facilitate ecotourism. Developing environmental education programs with other educational institutions and groups in the community would create a good working relationship with the community and public, increasing their interest in working with Blackwater Refuge to help develop ecotourism. Working with the respective County Tourism Offices and the community to increase ecotourism would help increase the economy of the local area even more.

Hiring a Volunteer Coordinator would enable these refuges to make better use of volunteer talents and interests, make the best use of volunteers to meet refuge needs, and recruit additional volunteers from the local community, developing more support for the community.

Working with the community, community organizations, tourism, schools, local businesses, news media, congressional entities, constituent groups, and state and local government agencies to develop programs, events, and activities can only increase the good association with the community and help establish a better understanding of these refuges, their missions and goals, wildlife, and wildlife habitats.

Interest in wildlife observation by walking, biking, canoeing, and riding in an automobile has been steadily increasing throughout the area. Refuge programs would add some structure and regulation to these activities that would be more compatible with wildlife and sensitive habitats. For example, after Blackwater Refuge was listed in the Maryland biking travel guides, the number of cyclists to Blackwater

Refuge increased from 842 in 1992 to 3,275 in 1995. Publications by Dorchester County, advertising Blackwater's trails, Wildlife Drive, and Visitor Center, have also attracted more visitors to Blackwater Refuge seeking opportunities for wildlife observation. According to the Dorchester County Department of Tourism, Blackwater Refuge visitors spend an estimated $15 million annually. Blackwater Refuge is the most utilized tourist attraction to Dorchester County. With the new Dorchester County Tourism Plan and the nearly completed construction of a new Hyatt Regency Conference Center in Cambridge, MD, the County anticipates attracting many more visitors to the area. Their encouragement of bus tours to Dorchester County has already increased the number of bus tours to Blackwater Refuge. Increased visitation to these refuges would have a positive impact on the local economy and would not adversely impact wildlife if properly planned.

Public Review and Comment:
This compatibility determination will be submitted for public review and comment as an appendices to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X_

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
These wildlife observation, photography, interpretive and environmental education uses have been conducted for many years and the special regulations, restrictions, and general operations have been structured to ensure compatibility. If the monitoring described under Availability of Resources indicates that this use materially interferes with or detracts from fulfillment of the National Wildlife Refuge System mission or the purposes of the refuge, we would curtail or eliminate the use.

Special Regulations governing our programs will are listed in the Code of Federal Regulations, Title 50, Parts 26 and 27, and will be subject to Maryland State regulations.

Justification:
Klein (1989) concluded in her study at "Ding" Darling Refuge that visitors were displacing 19 of the 40 species of waterbirds observed from foraging habitats "**at least some of the time.**" She furthermore stated that "**if the management of the refuge is to allow waterbirds to use the habitats available to their fullest extent, it will eventually be necessary to control visitor use.**" Klein, however, did not address the significance of these recreational uses at "Ding" Darling Refuge in reference to their effect on the purpose(s) for which the refuge was established, but one can interpret these summary recommendations as meaning that visitor disturbances at "Ding" Darling Refuge are certainly approaching the level that refuge purposes could be negatively affected. Conversely, given the comparisons discussed in the previous sections and the fact that Klein did not quantify what she termed as "critical levels" of disturbance until the number of vehicles exceeded 150 cars per day (most often between 150 and 300 cars per day), it is more obvious that the outdoor recreational uses of wildlife/wildlands observation (walking, hiking, and bicycling), photography, teacher/student environmental education workshops, and interpretation associated with the Wildlife Drive at Blackwater Refuge (for educational and recreation uses, cumulatively) are compatible because of the limited visitation and the very limited direct and indirect effects on the refuge's migratory birds and their habitats. The restrictions that Blackwater Refuge places on these activities; the ready availability of alternative, high quality habitats for waterfowl (400 acres of adjacent impoundments and croplands where no public use is allowed); the public outreach, enforcement and educational efforts that minimize wildlife disturbances; and the limited opportunities for disturbance resulting from the Wildlife Drive's spacial and temporal restrictions, all validate these uses as compatible.

Wildlife Observation, Photography, Interpretation, and Environmental Education will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which Blackwater Refuge was established.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 15 year Reevaluation Date: June 26, 2021

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COMPATIBILITY DETERMINATION

Use: Wildlife Observation, Photography, Interpretation, and Environmental Education

Station Name: Chesapeake Island Refuges

Establishing and Acquisition Authorities:
The Chesapeake Marshlands National Wildlife Refuge Complex (CMNWRC) is composed of three nationally significant wildlife areas: Blackwater NWR, Martin NWR, and Susquehanna NWR with several separate divisions. Blackwater NWR includes the Nanticoke Division, and Martin NWR includes the Barren Island, Bishops Head/Spring Island, and Watts Island Divisions. Collectively, Martin NWR, Susquehanna NWR, and the respective associated divisions are referred to as the Chesapeake Island Refuges.

The unconditional donation of 2,569.86 acres of land by the late Glenn L. Martin was the means whereby Martin NWR was established. In addition to the donations included in the December 1954 and January 1955 deeds, approval by the Migratory Bird Conservation Commission to purchase additional lands with Duck Stamp Funds resulted in increasing the refuge to its current size of 4,423 acres. The legal boundary of the refuge extends to the mean high water mark. A 1960 Secretarial Closing Order provided the refuge with a 300-yard wide proclamation boundary channelward of the mean high water mark which prohibits waterfowl hunting. Located in the middle, eastern portion of Chesapeake Bay, on Smith Island, the refuge lies in the heart of one of the largest waterfowl feeding grounds on the Bay. Martin is also home to the largest and most diverse colonial wading bird rookeries in the watershed.

This evaluation is to determine the compatibility of wildlife observation, photography, interpretation, and environmental education with the purpose for which Martin NWR was established. Such uses are not being considered for the before mentioned associated divisions to Martin.

Refuge Purpose(s):
For lands acquired under the Migratory Bird Conservation Act (16 U.S.C. § 715 d), the purpose of the acquisition is "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

National Wildlife Refuge System Mission:
"To administer a national network of land and waters for the conservation, management, and where appropriate, the restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57)."

Description of Use:
This evaluation is to determine the compatibility of wildlife observation, photography, interpretation, and environmental education with the purposes for which the affected tracts were acquired.

(A) What is the Use? Is the use a priority use?
The use is wildlife observation, photography, interpretation, and environmental education. The National Wildlife Refuge System Improvement Act of 1997 identified wildlife observation, photography, interpretation, and environmental education as four of the six, priority, wildlife-dependent recreational uses to be facilitated in the Refuge System, and the Act encouraged the Service to provide opportunities for these uses.

Background and Rationale for the Management Activity

When Martin NWR was first established as a refuge for migratory birds, the refuge was considered a sanctuary for wildlife. Few visitors came to the refuge. In recent years, people have begun to take an interest in Martin as a destination for ecotourism. A small visitor center with refuge information and exhibits is located in the Middleton House in the town of Ewell on Smith Island. Martin Refuge is closed to the general public to protect nesting and wintering waterbirds. Administrative support of Martin NWR is conducted from the Chesapeake Marshlands NWR Complex office in Cambridge, Maryland.

During CCP scoping meetings, the public expressed their desire for more facilities and public use of the refuge. In particular, they wanted increased opportunity for wildlife-oriented educational and interpretive programs, more opportunities for local school use and education, and a remodeled/new Visitor Center. Existing visitor center exhibits are in need of new, updated, and innovative displays to better inform the public of Service and refuge policies, wildlife needs, and awareness of wildlife conservation.

Proposed strategies include increasing environmental education programs (including the publication of an environmental education manual); increasing the number and types of interpretive and outreach programs, photography opportunities, and wildlife observation facilities; constructing an environmental education facility; updating exhibits, building a new visitor center; and hiring more staff to plan, manage, conduct, and operate the public use program. These strategies assume new lands be purchased in the town of Ewell for an environmental/education/research facility, outside of the sensitive nesting and wintering areas within the existing refuge boundary.

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(B) Where would the use be conducted?

A new visitor center would be constructed on vacant land not far from the Middleton House, in the town of Ewell. The Middleton House would be converted to office space and residence for refuge staff, visiting interns, volunteers, and researchers. At the new visitor center an observation tower would be constructed, along with facilities which highlight Chesapeake Bay ecology, and the waterman culture of Smith Island. Facilities would include displays and hand-on exhibits such as crab shedding tanks, fishing gear demonstrations, fish and oyster rearing tanks, duck traps, and wetland and submerged aquatic vegetation nurseries. Tours to the refuge proper would be conducted by refuge staff during times of the year when disturbance to trust resources (e.g. nesting colonial waterbirds) can be minimized. Although the refuge can prohibit migratory bird hunting within the Proclamation Boundary, waters surrounding and interior to the refuge are outside the jurisdiction of the Service. Scheduled refuge tours should help minimize boating disturbance on State of Maryland waters. Environmental education, in particular with school groups, will be done jointly with the Chesapeake Bay Foundation's environmental education program

(C) When would the use be conducted?

Wildlife observation and photography will be at the new visitor center daily, year-round, from dawn to dusk (i.e., daylight hours only), unless there is a conflict with a management activity or extenuating circumstance that would necessitate deviations from these procedures. Boat tours of the refuge would be conducted by refuge staff and the Chesapeake Bay Foundation during Spring, Summer, and Fall. No tours would be conducted during the winter waterfowl period. No entrance buffer zones will be established around critical colonial waterbird nesting rookeries to avoid disturbance. Non-tour boating access throughout Maryland State waters will not change.

(D) How would the use be conducted?

Because Smith Island is only accessible by boat, public visitation to the visitor center will be restricted to foot traffic. The new visitor center will be within an easy walking distance from the boat ferry which runs between Smith Island and Crisfield, Maryland. The observation tower, examples of habitat restoration, and fishing and crabbing operations will be on the visitor center property. Tours of the refuge property will be conducted by boats operated by refuge staff and the Chesapeake Bay Foundation, and landing areas will be

designated and restricted. Opportunities will be provided for refuge visitors to leave the boats in order to experience the wetland and beach habitats on foot.

(E) Why is the use being proposed?

These uses will be conducted to provide compatible educational and recreational opportunities for visitors to enjoy the resource and to gain understanding and appreciation for fish and wildlife, wildlands ecology and the relationships of plant and animal populations within the ecosystem, and wildlife management. They will enhance the public's understanding of natural resource management programs and ecological concepts to enable the public to better understand the problems facing our wildlife/wildlands resources, to realize what effect the public has on wildlife resources, to learn about the Service's role in conservation, to better understand the biological facts upon which Service management programs are based, and to foster an appreciation as to why wildlife and wildlands are important to them. The authorization of these uses will produce a more informed public, and advocates for Service programs. Likewise, these uses will provide opportunities for visitors to observe and learn about wildlife and wildlands at their own pace in an unstructured environment and to observe wildlife habitats firsthand. Professional and amateur photographers will also be provided opportunities to photograph wildlife in their natural habitats. Photographic opportunities obviously will result in increased publicity and advocacy for Service programs. These uses will also provide wholesome, safe, outdoor recreation in a scenic setting, with the realization that those who come strictly for recreational enjoyment will be enticed to participate in the more educational facets of the public use program, and can then become advocates for the refuge and the Service.

Availability of Resources:

Requested additional staff will develop and conduct more environmental education programs for different age groups, types of groups (including scouts, 4-H, college, adults, etc.) and for larger numbers of groups; develop an Envirothon for middle and elementary schools; develop communication workshops and meetings with other environmental education organizations and institutions; hold teacher workshops; recruit and train more volunteers; prepare and present more interpretive programs; develop a video; revise leaflets and develop new ones; update kiosk information; develop needed signs; catalog and store slide, photos, and historical items; develop habitat demonstration areas; plan and conduct photography programs; organize and conduct more events; regularly schedule programs for the public; work with Somerset County Tourism, National Park Service, Gateways Program and other organizations to plan events and activities; display off-site exhibits at more local events; develop ecotourism with Somerset County Tourism; participate in the development of watershed-wide cooperative outreach groups; develop better relationships with media providing monthly reports; and be able to respond immediately to public inquiries.

Cost Breakdown:

The following is the list of costs to the refuge required to administer and manage wildlife observation, photography, interpretation, and environmental education programs.

<u>Yearly Service Staffing Costs</u>

Refuge Operations Specialist GS-0485-12 (20%).....$	17,616
Outdoor Recreation Planner GS-0023-5/7 (75%).....$	31,034
Biologist GS-0486-5/7 (10%).....$	4,138
Small Craft Operations WG-5786-9 (20%).....$	11,930
Maintenance Worker WG-4749-4 (20%).....$	7,392
SCEP (Refuge Manager, 0.5 FTE) GS-0499-5/7 (20%).....$	4,138
Law Enforcement Officer GS-0025-5/7 (20%).....$	8,276
Total.....$	84,524

Facility and Equipment Costs

Construct observation platform.....$	38,000
Construct new visitor center.....$	1,500,000
Land acquisition.....$	500,000
Construct aquaculture and nursery facilities.....$	100,000
Construct demonstration wetland habitat restoration.....$	500,000
Exhibits, outreach & materials for waterman culture interpretation.....$	124,000
Install traveler's station.....$	38,000
Construct photo blind.....$	15,000
2 tour boats.....$	30,000
Total.....$	2,845,000

Anticipated Impacts on Refuge Purpose(s):
The following is a summary of the environmental, socioeconomic, and cultural/historical impacts of these programs as more thoroughly described in the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment.

Physical Impacts: Construction of the visitor center, observation tower, traveler's station, aquaculture and nursery facilities, photo blind, and habitat restoration projects will occur in prior disturbed habitats. The property includes an old house site, former dredged material disposal area, and bare soil areas used by local youth for bicycling and dirt bike riding. Fallow areas associated with the house site consists of early successional weeds, shrubs, and young trees. Construction of the visitor center will include habitat landscaping with native plant species, which will improve the locations habitat value to passerine bird species and butterflys. Wetland habitat restoration will improve habitat for waterfowl, wading birds, and estuarine aquatic resources. No expanded footprint of existing roadways will be required with the exception of a new driveway for refuge staff access to the visitor center. Because the site will be accessed by the public by walking from the ferry landing to the visitor center, parking will not be required. During construction activities, best management practices and storm water runoff/sedimentation plans would be implemented to minimize erosion or degradation to water quality. Overall, physical impacts should be very minimal, with an end result in improvement to the acreage and quality of habitat over existing conditions.

Biological Impacts: At Martin NWR, public use can potentially interfere with normal migratory bird and other wildlife habits in several ways. One is the disruption of normal foraging and social behavior of wildlife by feeding (Edington and Edington, 1986). Van der Zande (1980) defined such disturbance as "emission of stimuli to which animals may respond by avoiding the vicinity...". Several studies have also found correlations between human-use levels and bird densities (Erwin, 1980; Madsen, 1985; Werschkul et al, 1976.) High levels of disturbance may keep ducks from building up enough energy reserves over the winter to meet subsequent reproductive requirements (Hohman et al, 1988). Pair-bonding may likewise be adversely affected when disturbance is high (Anderson et al, 1988). In addition, the effects of common human actions, including specific recreational activities, have been examined by Burger (1981, 1986) and Vos et al (1985), and these actions can, at certain levels, influence a wide diversity of migratory waterbirds (Klein, 1989).

The concern, therefore, is whether or not these disturbances are sufficient to adversely affect the subject purpose(s) for which the refuge was established. Several major evaluation criteria will be used to make this determination: percentage of the refuge's habitats affected; the number of visitors; location of boating/landing destinations and their juxtaposition to important habitats; types of human behavior (treatments) and the types of activities visitors participate in; timing of visitation; importance of visitation area to migratory birds; species composition; enforcement and education; presence of "escape cover;" and location of high-quality foraging areas in relationship to line of sight from human intrusion.

All of the new proposed facilities will be sited in existing low value habitat, therefore no increased disturbance to wildlife is anticipated. Conversely, habitat improvements will attract new species and greater numbers of these species to the visitor center and observation tower area. Boat tours and public landings on Martin NWR will be scheduled and managed to minimize disturbance to Service trust resources. Time of year restrictions on boat tours during the winter waterfowl season will minimize disturbance to migratory ducks and geese. The availability of the tours should help decrease unmanaged access throughout the waterways surrounding and interior to Martin NWR, which are outside the regulatory authority of the Service. Critical waterbird rookies will be posted, and an adequate no access buffer zone will be established for the boat tours. Public landing areas associated with the boat tours will be sited outside of critical habitats. No public landings will be allowed on Martin NWR outside of the Service and Chesapeake Bay Foundation boat tours.

Additional facilities would result in moderate disturbance to wildlife while under construction. These impacts would be short lived and should not significantly affect Federal trust resource species in the long-term. The photo blind may negatively impact a few wildlife while being constructed, but should have little or no impact on wildlife and their habitats after construction. These facilities would be sited to avoid endangered species habitats and sensitive areas. After construction, the photo blinds would actually help to minimize disturbance by focusing photographic opportunities on specific areas where photographers are out of view of wildlife and where they are not as likely to wander into sensitive areas. Impacts attributable to environmental education and interpretation would be mitigated by the benefits of educating the public about refuge resources and the environment.

Obviously, with improved facilities, there would be increased visitation. Disturbance, however, would remain minimal overall since most of the these public use facilities will be sited in an area of low habitat value. Increased boating by Service staff will be managed as previously stated. Also, the expanded facilities would occur in areas where wildlife have habituated to human activities over the course of over 400 years (when the Town of Ewell was established).

Socioeconomic Impacts: A new Visitor Center at Martin Refuge with new exhibits, environmental education materials, and increased number of activities and facilities would reach a much greater segment of the public. Up-to-date information that promotes Martin Refuge and the Service mission and goals will create support for wildlife both on and off the Refuge. As facilities are enhanced, the possibilities for a quality experience are enhanced. As more people enjoy quality experiences, visitation would increase. Thus, the communities surrounding Martin Refuge would benefit through increased use of their facilities, service stations, lodging, and restaurants.

Somerset County is developing a Tourism Management Plan that will increase and facilitate ecotourism. Developing environmental education programs with other educational institutions and groups in the community would create a good working relationship with the community and public, increasing their interest in working with Martin Refuge to help develop ecotourism. Working with the County Tourism Office and the community to increase ecotourism would help increase the economy of the local area even more. Working with the community, community organizations, tourism, schools, local businesses, news media, congressional entities, constituent groups, and state and local government agencies to develop programs, events, and activities can only increase the good association with the community and help establish a better understanding of these refuges, their missions and goals, wildlife, and wildlife habitats.

Interest in wildlife observation has been steadily increasing throughout the area. Refuge programs would add some structure and regulation to these activities that would be more compatible with wildlife and sensitive habitats. Increased visitation to this refuge would have a positive impact on the local economy and would not adversely impact wildlife if properly planned.

Public Review and Comment:
This compatibility determination will be submitted for public review and comment as an appendices to the Environmental Assessment for the Draft Comprehensive Conservation Plan for the Chesapeake Marshlands NWR Complex in full compliance with NEPA.

Determination: (Check One)

This use is compatible _X

This use is not compatible ____

Stipulations Necessary to Ensure Compatibility:
These wildlife observation, photography, interpretive and environmental education uses have been conducted for many years and the special regulations, restrictions, and general operations have been structured to ensure compatibility. If future monitoring indicates that this use materially interferes with or detracts from fulfillment of the National Wildlife Refuge System mission or the purposes of the refuge, we would curtail or eliminate the use.

Special Regulations governing our programs will are listed in the Code of Federal Regulations, Title 50, Parts 26 and 27, and will be subject to Maryland State regulations.

Justification:
The justification for allowing the subject uses is described in detail throughout both the Alternatives section and Consequences section of the Environmental Assessment prepared for the Chesapeake Marshlands NWR Complex's Comprehensive Conservation Plan of which this document is an attachment. Wildlife Observation, Photography, Interpretation, and Environmental Education will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the Refuge was established.

Signature - Refuge Manager: __/s/ Glenn A. Carowan 1/30/2006_____
(Signature and Date)

Concurrence - Regional Chief: __/s/ Anthony D. Legér 6/26/2016_____
(Signature and Date)

Mandatory 15 year Reevaluation Date: June 26, 2021

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Appendix F. Wilderness Review

USFWS

The Chesapeake Bay islands provide unique habitats for colonial nesting birds

Introduction

The purpose of a wilderness review is to identify and recommend to Congress lands and waters of the National Wildlife Refuge System (NWRS) that merit inclusion in the National Wilderness Preservation System (NWPS). Wilderness reviews are required elements of comprehensive conservation plans, are conducted in accordance with the refuge planning process outlined in the Fish and Wildlife Service Manual (602 FW 1 and 3), and include compliance with the National Environmental Policy Act and public involvement.

The wilderness review process has three phases: inventory; study; and, recommendation. In the inventory phase, we assess wilderness inventory areas (WIAs) under the minimum criteria for wilderness. Lands and waters that meet those criteria then are called wilderness study areas (WSAs). In the study phase, we evaluate a range of management alternatives to determine whether a WSA is suitable for wilderness designation or for management under an alternate set of goals and objectives that do not involve wilderness designation.

The recommendation phase consists of forwarding or reporting the suitable recommendations from the Director through the Secretary and the President to Congress in a wilderness study report. We prepare the wilderness study report after the record of decision for the final CCP has been signed. Areas recommended for designation are managed to maintain their wilderness character in accordance with management goals, objectives, and strategies outlined in the final CCP until Congress makes a decision or the CCP is amended to modify or remove the wilderness proposal.

The Chesapeake Marshlands National Wildlife Refuge Complex (NWRC) personnel and Region 5 personnel listed at the end of this appendix met on September 2, 2004, to gather information and conduct an inventory of the refuge lands and waters. That process required combining site knowledge with existing land status maps, photographs, available land use information, and road inventory data to determine whether the refuge lands and waters met the minimum criteria for wilderness. Aerial photographs were used to document the imprint of human work, road locations, and other surface disturbances.

Phase I. Wilderness Inventory

Introduction

The wilderness inventory that follows is a broad look at each of eight WIAs to identify any WSAs (see figure F.1, “Wilderness inventory areas in the Chesapeake Marshlands NWRC,” below). A WSA is an area of undeveloped Federal land that retains its primeval character and influence, without permanent improvements or human habitation, and further, meets the minimum criteria for wilderness identified in section 2(c) of the Wilderness Act.

Figure F.1. Wilderness inventory areas in the Chesapeake Marshlands NWRC

Minimum Wilderness Criteria

A WSA is required to be a roadless area or island, meet the size criteria, appear natural, and provide for solitude or primitive recreation.

Roadless.—Roadless refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. A route maintained solely by the passage of vehicles does not constitute a road. Only Federal lands are eligible to be considered for wilderness designation and inclusion within the NWPS.

The following factors were the primary considerations in evaluating the roadless criteria.

A. The area does not contain improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use.

B. The area is an island, or contains an island that does not have improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use.

C. The area is in Federal fee title ownership.

Size.—The size criteria can be satisfied if an area has at least 5,000 acres of contiguous roadless public land, or is sufficiently large that its preservation and use in an unimpaired condition is practicable.

The following factors were the primary considerations in evaluating the size criteria.

A. An area of more than 5,000 contiguous acres. State and private lands are not included in making this acreage determination.

B. A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.

C. An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.

D. An area of less than 5,000 contiguous acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Naturalness.—The Wilderness Act, section 2(c), defines wilderness as an area that "generally appears to have been affected primarily by the forces of nature with the imprint of human work substantially unnoticeable." The area must appear natural to the average visitor, rather than "pristine." The presence of historic landscape conditions is not required.

An area may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Significant hazards caused by humans, such as the presence of unexploded ordnance from military activity and the physical impacts of refuge management facilities and activities are also considered in evaluating the naturalness criteria.

An area may not be considered unnatural in appearance solely on the basis of the sights and sounds of human impacts and activities outside the boundary of the unit. The cumulative effects of these factors in

conjunction with land base size, physiographic and vegetative characteristics were considered in the evaluation of naturalness.

The following factors were the primary considerations in evaluating naturalness.

A. The area appears to have been affected primarily by the forces of nature with the imprint of human work substantially unnoticeable.

B. The area may include some human impacts provided they are substantially unnoticeable in the unit as a whole.

C. Does the area contain significant hazards caused by humans, such as the presence of unexploded ordnance from military activity?

D. The presence of physical impacts of refuge management facilities and activities.

Solitude or Primitive and Unconfined Recreation.—A WSA must provide outstanding opportunities for solitude or primitive and unconfined recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criteria; Congress has designated a number of wilderness areas in the Refuge System that are closed to public access to protect resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk; self reliance; and adventure. These two elements are not well defined by the Wilderness Act, but can be expected to occur together in most cases. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

The following factors were the primary considerations in evaluating outstanding opportunities for solitude or primitive unconfined recreation.

A. The area offers the opportunity to avoid the opportunity avoid the sights, sounds and evidence of other people. A visitor to the area should be able to feel alone or isolated.

B. The area offers non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport.

Supplemental Values.—The Wilderness Act states that an area of wilderness may contain ecological, geological, or other features of scientific, educational, scenic or historical value. Supplemental values of the area are optional, but the degree to which their presence enhances the area's suitability for wilderness designation should be considered. The evaluation should be based on an assessment of the estimated abundance or importance of each of the features.

Summary of Wilderness Inventory Findings

The wilderness inventory team identified eight wilderness inventory areas in the Chesapeake Marshlands NWRC. The team's findings for each WIA are summarized below. See also figure F.1, "Wilderness inventory areas in the Chesapeake Marshlands NWRC," above, and "table F.1, "Tabular Summary of the Chesapeake Marshlands NWRC Wilderness Inventory Areas" at the end of this appendix.

The team eliminated from consideration a total of 12,000 acres of the Blackwater NWR, (the gold-colored areas in figure F.2, "Jarrett Tract and East Shorters' Wharf Marsh WIAs," below), because they do not meet the roadless, naturalness, or solitude criteria, based on one or more of the following factors. The imprint of human work is obvious and prominent throughout those areas, which are divided by county and state roads, agricultural fields, impoundments, buildings, parking lots, utility rights-of-way, ditches, refuge roads, and levees. State and county roads and utility rights-of-way divide those areas of the refuge into numerous small parcels.

Ongoing refuge management activities there include agricultural planting, mowing, and managing impoundments. Numerous roads, ditches, and levees are present in the forested wetlands, as well as evidence of past logging operations, including logging roads, ditching, dozer piles, and push ponds. The 12,000 acres also contain developed areas for maintenance, visitor services, and administration, with all their associated parking areas, tour roads, and office and storage facilities. Traffic along state and county roads is constantly visible or within hearing of any location within this unit. Boat traffic is evident within much of the unit, as well.

One major goal of our CCP is the conversion and restoration of marsh habitat. Over the next 15 years, restoring the marsh habitat in those areas of Blackwater NWR will involve dredging, laying pipelines, constructing sedimentation barriers, and fencing. That marsh restoration will contribute in a major way to the purposes for which the refuge was established

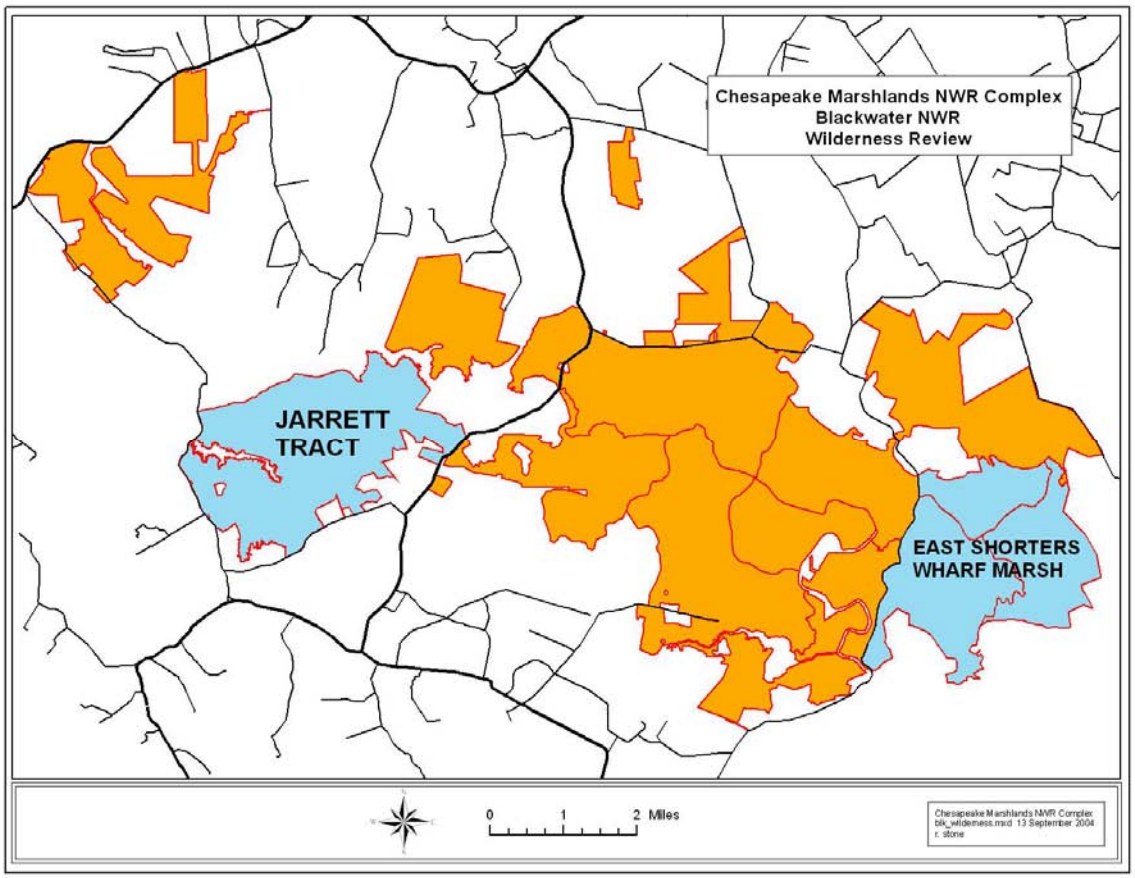

Figure F. 2. Jarrett Tract and East Shorters' Wharf Marsh WIAs

Watts Island

The Watts Island WIA does not meet the criteria for a WSA. Watts Island is approximately 125 acres in size, and comprises both marsh and forest habitats. The marsh and woodland fringe serve as prime nesting grounds for American black ducks, excellent wintering habitat for other migratory waterfowl, and foraging habitat for peregrine falcons and other raptors. The woodlands comprise mostly loblolly pines, which provide nest sites for a diversity of wading birds. Watts Island is the largest wading bird rookery in the state of Virginia. All of Watts Island is roadless, although it was inhabited at one time.

Evidence of the fact that humans once inhabited Watts Island can be found in the form of several old house foundations located on the higher elevations of the island. More recent imprints of human work include a small utility building, which houses phone cable that runs under the bay. Watts Island also contains peregrine falcon hacking towers, built and maintained by the refuge. Those towers have produced numerous falcons over the years. In fact, two falcons reared from those towers have been equipped with satellite transmitters, and are part of a large-scale telemetry study. Due to that success, we do not plan to do away with the peregrine towers on Watts Island. The peregrine towers have significant scientific and educational value.

The number one reason islands are so beneficial for nesting wading birds and waterfowl is the fact that they are isolated from the impacts of human and mammalian predators. Watts Island is closed to the public, due to the cumulative disturbance factors that will negatively impact all of the wildlife species these islands protect. Opening the island to public recreation would significantly reduce its value as a wading bird rookery, because most activity will take place on the upland areas. Public recreation also would result in excessive disturbance to all nesting water birds, wintering waterfowl, endangered species and other trust resources. Also, opening these lands to the public would require a degree of law enforcement presence that is very difficult to provide on these remote lands.

Despite the fact that Watts Island is in the middle of the Chesapeake Bay, its relatively small size and very narrow shape would make it impossible to escape the frequent boat traffic from commercial and recreational crabbers and fishermen or the occasional wave runner. Also, due to inherent difficulties with providing law enforcement, it is possible that trespassing may occur on to the island. The Service frequently issues special use permits to other agencies to perform various surveys and research, which would also compromise a wilderness experience.

Martin NWR

The Martin NWR WIA does not meet the criteria for a WSA. A wilderness inventory was conducted for Martin NWR in 1971, at which time it was declared not suitable for inclusion within the National Wilderness Preservation System. Little has changed to improve its wilderness attributes such as roadlessness, naturalness, or solitude. In fact, the number of artificial nest structures for American osprey has increased to more than 75. Also, due to the accelerated rates of erosion and loss of habitat exhibited by all Bay islands, the need to protect those lands from human disturbances and predators has significantly increased. The island contains numerous imprints of humans, including a maintenance building, fire tower, two peregrine falcon hacking towers, and a dock and concrete bulkhead structure. The island does not meet the solitude criteria, due to its close proximity to frequent commercial and recreational crabbing and fishing boat traffic.

Spring Island

The Spring Island WIA does not meet the criteria for a WSA. Spring Island was 52 acres in size but, due to erosion, the island is now only about 34 acres in size. As with all of the unprotected or reinforced islands within the Chesapeake Bay, Spring Island is eroding at an alarming rate. As marsh and shrub vegetation are lost, the rate of erosion becomes more and more accelerated. Without human intervention, it is very likely that Spring Island will be gone within the next 10 years. Spring Island has been informally proposed

as a disposal site for dredge material. The refuge will likely pursue the option to protect the island from future erosion by constructing offshore rock breakwaters.

The island is roadless. Its habitat consists of marsh, sandy shoreline and shrub-scrub. The marsh and sandy shore provide both nesting and foraging habitat for a variety of colonial nesting birds and shore birds, while the shrub-scrub habitat provides nesting habitat for smaller wading birds like black-crowned night-herons, green herons and, in more recent years, brown pelicans. Spring Island contains prime nesting habitat for brown pelicans and other colonial nesting birds.

Allowing public recreation will directly and significantly detract from the island's benefits to colonial nesting birds and shore birds. Public recreation would also result in excessive disturbance to all nesting water birds, wintering waterfowl, endangered species, and other trust resources. The island's size and habitat types do not allow for quality recreation opportunities.

Spring Island does not meet the solitude criteria due to its small size, which also makes it impossible to escape the frequent commercial and recreational crabbing and fishing boat traffic. Also, due to its low-lying vegetation, any visitors would be noticeable from great distances. Due to its rate of erosion and its potential as a future disposal site for dredge material, Spring Island does not meet the naturalness criteria, and is not considered practicable for preservation and use in an unimpaired condition.

Bishop's Head Division

The Bishop's Head Division WIA does not meet the criteria for a WSA. Bishop's Head is 380 acres, and was purchased under the Migratory Bird Conservation Act "for use as an inviolate sanctuary, or for other management purposes, for migratory birds." Most of the habitat on the Bishop's Head division is salt marsh, with some wooded hammocks and some shrub-scrub. Bishop's Head does not meet the roadless criteria, and is joined to the mainland via a paved county road.

In addition to the paved access road and several associated drainage culverts, Bishop's Head Point is the location of the Chesapeake Bay Foundation's Karren Noonan Environmental Education Center. The center consists of a main education center, intern housing, sewage facilities, and an 80-foot dock. A 200-foot DOD military radio tower stands directly adjacent to the refuge.

The Bishop's Head Division is closed to most public recreation due to the potential disturbances to endangered species and nesting marsh and water birds. Also due to the lack of adequate law enforcement, we are not able to ensure resource protection and visitor safety.

This division does not meet the solitude criteria, due the frequent environmental education activities hosted by the Chesapeake Bay Foundation and easy access to most of the land along the unrestricted county road. The division is not of sufficient size to make practicable its preservation and use in an unimpaired condition, nor is it of a size suitable for wilderness management. It is less than 5,000 acres; its use in an unimpaired condition is not practical, and is contrary to refuge management objectives.

Barren Island Division

The Barren Island Division WIA does not meet the criteria for a WSA. Barren Island was 177 acres when purchased, and is now approximately 160 acres as a result of erosion. The island is roadless, but has evidence of ditching and a gravel airstrip. It was once inhabited, was farmed and burned, and contains many piles of debris. Its habitats consist of high marsh (*Spartina patens* and black needle-rush), low marsh (dominated by *S. alternaflora*), beach, and woodlands dominated by loblolly pine with a poison ivy and American holly understory. The island contains some stands of phragmites. Erosion recently cut the island into two distinct land masses.

During the past several years, the beneficial use of dredge material has created about 20 acres of tidal wetland. The initial phase of this project consisted of the creation of more than 10 acres of wetlands and the placement of geo-tubes to provide shoreline erosion protection. The second phase of this project consisted of constructing several thousand feet of offshore rock breakwaters and repairing all failed geo-tubes by placing rock on top of them. An additional 10 acres of tidal wetlands were then created by depositing clean dredge material from local navigational channel maintenance projects.

Earlier evidence of human inhabitants consists of remnants of old hunting lodge, abandoned air strip, abandoned drag line machine, large ditches, dock pilings, old storage tanks and several debris piles created by early settlers. Also, large storms and tidal surges have scattered debris of human origin across much of the island. Several American osprey nest structures are on the island.

Given the lack of law enforcement and capabilities we cannot ensure visitor safety and solitude. Allowing public recreation will directly and significantly detract from the island's benefits to colonial nesting birds and shore birds. Public recreation would also result in excessive disturbance to all nesting water birds, wintering waterfowl, endangered species and other trust recourses. The island's size and habitat types do not allow for quality recreation opportunities.

The relatively small size and narrow shape of the island would make it impossible to escape the frequent boat traffic of commercial and recreational crabbers and fishermen or the occasional wave-runner. Also, due to inherent difficulties with providing law enforcement, it is possible that trespassing may occur on the island. The Service frequently issues special use permits to other agencies to perform various surveys and research, which would also compromise a wilderness experience.

The island contains a major wading bird rookery, including the only known nesting site for black skimmers in Maryland. It is also a nesting site for least terns, brown pelicans, American black ducks, American osprey, American bald eagles and diamond-back terrapins.

The unit is not of sufficient size to make practicable its preservation and use in an unimpaired condition, nor is it of a size suitable for wilderness management. It is less than 5,000 acres; its use in an unimpaired condition is not practical, and is contrary to refuge management objectives.

Susquehanna NWR

The Susquehanna NWR WIA does not meet the criteria for a WSA. Susquehanna NWR, also known as Battery Island, is only 1.5 acres in size, is completely protected by rock rip-rap, and has a small dock. Its habitat consists of shrubs and small trees. There are no roads on the island, nor any known archaeological sites.

The nationally registered Battery Lighthouse located on the refuge is owned by the U.S. Coast Guard, who have maintained the lighthouse since the 1920s. Executive Order No. 9185 reserves a 45´×45´ area for the lighthouse and keeper's quarters. The newly formed Chesapeake Heritage Conservancy Battery Island Preservation Society is now trying to obtain the island through lease or transfer, so that they can properly protect and maintain its historic lighthouse and keeper's quarters.

The small size and narrow shape of the island would make it impossible to escape the frequent boat traffic of commercial and recreational crabbers and fishermen or the occasional wave-runner. Also, due to the difficulties inherent in providing around-the-clock law enforcement, it is possible that unauthorized personnel may venture onto the island. The Service frequently issues special use permits to other agencies to perform various surveys and research, which would also compromise the wilderness experience.

Jarrett Tract—Blackwater NWR

This WIA, depicted in figure F.2 does not meet the criteria for a WSA. This 3,674-acre unit lies in the western area of the main section of Blackwater NWR, and is roughly bounded by Route 335 on the east, Hip Roof Road on the south, and Smithville Road on the west. Most of its habitat consists of forested wetlands, but about 1,000 acres consists of open water and marsh. Fifty acres of agricultural fields lie to the north of Hip Roof Road.

The imprint of human work is clearly noticeable throughout the unit. Although it is considered roadless under the Wilderness Act definition, numerous roads, ditches, and levees lie within the unit, which also exhibits much evidence of past logging operations, including logging roads, ditching, bulldozer piles, and push ponds. Agricultural fields lie fallow in its southern section.

Due to the openness of the marsh habitats within the unit and the proximity of Hip Roof Road, Route 335, and Smithville Road, there is no seclusion or opportunity for primitive recreation. The boat traffic of fishermen and trappers on Beaver Dam Creek and frequent vehicle traffic along the west, south, and east boundaries of the unit preclude any possibility of solitude.

In addition to its being less than 5,000 acres in size, the use of this unit in an unimpaired condition is not practical, and is contrary to refuge management objectives.

East Shorters' Wharf Marsh—Blackwater NWR

This WIA, depicted in figure F.2, above, does not meet the criteria for a WSA. The area east of Shorters' Wharf Road is bounded by the refuge on the east, the Kuehnle Tract on the north, and the Blackwater River on the south. Although it contains 3,638 acres, probably less than half of that is marsh, due to marsh loss and the ongoing trend toward more and more open water. There are no roads within the area, but it is used by trappers, researchers, and others with motor boats.

The conversion and restoration of marsh habitat within the refuge is a major goal of the CCP. Habitat restoration in this unit will involve dredging, pipelines, sedimentation barriers, and fencing. That ongoing restoration over at least the next 15 years will make major contributions to the purposes for which the refuge was established.

Due to the openness of its marsh habitat and the proximity of Shorters Wharf Road and the Blackwater River channel, the area offers no seclusion or opportunity for primitive recreation. Frequent boat traffic and nearly constant vehicle traffic along the west and south boundaries of the unit preclude any possibility of solitude.

The unit is not of sufficient size to make practicable its preservation and use in an unimpaired condition, nor is it of a size suitable for wilderness management. It is less than 5,000 acres; its use in an unimpaired condition is not practical, and is contrary to refuge management objectives.

Conclusion

The Service finds that none of the WIAs in the Chesapeake Marshlands NWRC, Cambridge, Maryland, meets the minimum criteria to qualify as a WSA as defined by the Wilderness Act (see table F.1, "Tabular Summary of the Chesapeake Marshlands NWRC Wilderness Inventory Areas," below). The refuge is not considered further for possible wilderness designation in its CCP.

Wilderness Review Team

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Table F.1. Tabular Summary of the Chesapeake Marshlands NWRC Wilderness Inventory Areas

Wilderness Inventory Area	*Size*	*Roadless*	*Naturalness*	*Primitive Recreation or Solitude*	*Supplemental Values*	*Qualifies as WSA?*
Watts Island	125 ac.	Yes	No. Numerous structures	PrimRec: Closed Solitude: No. Boat traffic	Largest wading bird rookery in VA	No
Martin NWR	5,500 ac.	Yes	No. Numerous structures	PrimRec: Closed Solitude: No. Town and vehicle traffic sights and sounds	Colonial nesting birds, American osprey nesting habitat	No
Spring Island	34 ac.	Yes	No. Severe erosion	PrimRec: Closed Solitude: No. Boat traffic	Nesting habitat for brown pelicans, other colonial nesting birds; peregrine falcons	No
Bishops Head Division	380 ac.	No	No. Numerous structures	PrimRec: No Solitude: No	Excellent education facility managed by cooperative agreement	No
Barren Island Division	177 ac.	No	No. Numerous structures	Prim. Recreation: No Solitude: No. Boat traffic	Major rookery for wading birds; only known black skimmer nesting site in MD; bald eagles, least terns, brown pelicans, osprey, etc.	No
Susquehanna NWR	1.5 ac.	Yes	No. Numerous structures	PrimRec: No Solitude: No	Historical and cultural values	No
East Shorters' Wharf Marsh BLK	3,638 ac.	Yes	Ongoing marsh habitat restoration	PrimRec: No Solitude: No	None	No
Jarrett Tract BLK	3,674 ac.	No	No. Evidence of logging, push ponds ditching, agricultural fields	PrimRec: No Solitude: No	None	No

Chesapeake Marshlands National Wildlife Refuge Complex
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Cambridge, MD 21613
410/228 2692
e-mail: fw5rw_bwnwr@fws.gov

http://blackwater.fws.gov/

Federal Relay Service
for the deaf or hard of hearing
1800/877 8339

U.S. Fish and Wildlife Service Website
http://www.fws.gov

For National Wildlife Refuge System Information:
1800/344 WILD

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